RAFFERTY-ALAMEDA PROJECT

ENVIRONMENTAL IMPACT STATEMENT

Souris Basin
Development
Authority

CHAPTER 5

GEOLOGY & MINERAL RESOURCES

RAFFERTY/ALAMEDA ENVIRONMENTAL IMPACT STATEMENT

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Executive Summary Report

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Chapter 10 Natural Vegetation

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Chapter 12 Land Use

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Chapter 14 Fisheries

Chapter 15 Wildlife

Chapter 16 Heritage Resources

Chapter 17 Recreation
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  (b) - Lutheran Bible Camp
  (c) - Dr. Mainprize Regional Park

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GEOLOGY AND MINERAL RESOURCES

INTRODUCTION

Geology and mineral resources are key components of the terrestrial environment in terms of evaluating potential impacts from the proposed Rafferty and Alameda dams and reservoirs during their construction, operation and eventual abandonment.

Mineral resources predicted to be affected by the dams and reservoirs include: sand, gravel and oil.

For purposes of this discussion, the geological assessment area covers an irregular quadrangle bounded on the southwest by Oungre, by Weyburn on the northwest, by Glen Ewen on the southeast and Carlyle on the northeast. This area thus includes the proposed Rafferty and Alameda dams and reservoirs. The landscape is described in terms of its principal components - surficial geological deposits, shallow bedrock and primary mineral resources. These descriptions provide baseline information on the extent and character of each geologic unit.

The geological information discussed is based on a review of aerial photographs as well as an assessment of earlier reports and material supplied by the Saskatchewan Research Council. Descriptions are based on studies by Christiansen (1956 and 1978), Whitaker and Christiansen (1972) and Whitaker (1974). Specific information regarding sand and gravel deposits and oil well information in the proposed Rafferty reservoir area was obtained from the Saskatchewan Research Council (1985), Saskatchewan Energy and Mines (1985a & 1985b), from PanCanadian Petroleum Limited and from Cochrane Lavalin (1985). For the proposed Alameda reservoir, the geological evaluations of Mollard (1982 and 1984) were reviewed, and oil well information was obtained from Cochrane Lavalin (1985) and from Esso Resources Canada Limited (1985).

GENERAL GEOLOGY

The area under review lies within the Saskatchewan portion of the Souris River Basin which is situated within the northern part of the Williston Sedimentary Basin. Sedimentary rocks overlie igneous and metamorphic rocks of

Precambrian age and dip gently southward to the central part of the Williston Basin.

The orogenic processes which created the Rocky Mountains uplifted these sedimentary formations above sea level during the latter part of the Cretaceous period. Multiple continental glaciations during the Pleistocene period eventually modified the bedrock surface and created present day drainage systems. The valley in which the Souris River flows was formed during the final deglaciation of western Canada. The Souris river valley formed as a meltwater channel which transmitted more water during the climax of deglaciation than at present, resulting in deep downcutting of the valley. Subsequent isostatic rebound of western Canada during the final deglaciation uplifted Hudson Bay, the ultimate discharge point of the Souris River, relative to the Souris River in Saskatchewan. Those factors caused the Souris River to become an underfit stream flowing through an over-deepened and alluviated valley incised far below the general level of the plains (Meneley 1972).

PHYSIOGRAPHY

The area lies within the Saskatchewan Plain division of the Interior Plains physiographic region (Bostock 1970). Locally, the area of interest is known as the Weyburn Plain (Christiansen 1956). This plain parallels the Souris River and lies between Moose Mountain to the northeast and the Missouri Coteau to the southwest. Most of the surface is nearly level to gently undulating. Relief is locally from 15 to 30 m with the greatest differences in elevation found between the alluvial plain which borders the Souris River and the top of the adjacent bench which parallels the river.

BEDROCK GEOLOGY

The broad bench which parallels the Souris River is underlain by Cretaceous and Tertiary bedrocks of the Riding Mountain and Ravenscrag Formations which are exposed locally. Similar formations are present beneath glacial deposits along Moose Mountain Creek, north of Oxbow in the vicinity of Alameda Reservoir.

The Cretaceous Riding Mountain Formation immediately underlies glacial deposits from Township 4 northward. The Ravenscrag Formation with minor occurrences of Frenchman, Whitemud, and Eastend Formations occurs beneath a cover of glacial deposits south of Township 4 along the Souris valley. The Ravenscrag Formation is found beneath glacial deposits along the entire proposed Alameda Reservoir.

The Ravenscrag Formation consists of interbedded sandstone, siltstone, claystone, and lignite. Locally it contains carbonaceous zones, kaolin zones, concretionary and calcareous zones (Whitaker 1974). Locally, the coal and clay shale in this formation has been excavated for previous surface and subsurface coal mines and clay pits. The sediments which formed the Ravenscrag Formation were deposited in an alluvial-deltaic environment during Tertiary time. They were compacted and eroded after deposition but before glaciation affected them (Mollard 1982). The Frenchman, Whitemud, and Eastend Formations are similar in lithology and origin to the Ravenscrag Formation except they lie beneath it stratigraphically. Only minor occurrences of these formations are found in Townships 4 and 5 along the Souris Valley.

The Riding Mountain Formation of Cretaceous age is gray, noncalcareous silty claystone and claystone that is locally bentonitic and concretionary. This formation evolved in an open marine environment.

Both the Riding Mountain and Ravenscrag Formations are poorly to well consolidated. They are competent for heavy structures, but have some zones with higher permeabilities such as coal and clay shale beds (Mollard 1982). The bedrock forms fairly steep banks along the bench adjacent to the Souris River and Moose Mountain Creek.

The bedrock surface was eroded and channeled during glacial as well as Tertiary times. These channels are referred to as the Estevan, Weyburn, Missouri and Yellowstone channels (Beckie 1985) and contain extensive sand and gravel deposits beneath a thick layer of till. These sand and gravel deposits have been called the Empress Unit (Whitaker and Christiansen 1972).

SURFICIAL GEOLOGY

Pleistocene glaciers covered the area during the Quaternary Period and created local topography by scouring bedrock and previous glacial deposits.

These glaciers molded previous deposits and soft bedrock, depositing sediments directly from the ice, and deposited and eroded material in glacial rivers and streams as well as diverting drainage channels.

.1 Rafferty Dam and Reservoir Site

The most common glacial deposit in the vicinity of the Rafferty Dam and Reservoir sites is moraine deposited directly from the glacier ice (Figures 1 and 2 and map legend Figure 3). These deposits are composed of sandy clay till with minor gravel lenses and may form veneer, plain, rolling moraine or ridged moraine landforms. These landforms represent ground moraine, dead ice moraine, and recessional moraine landforms (Christiansen 1956). Till in these landforms can be greater than 5 m in thickness but most commonly occurs from 1 m to 5 m thick. Ice thrust till has been reported in drillholes throughout the study area, but does not appear at the ground surface.

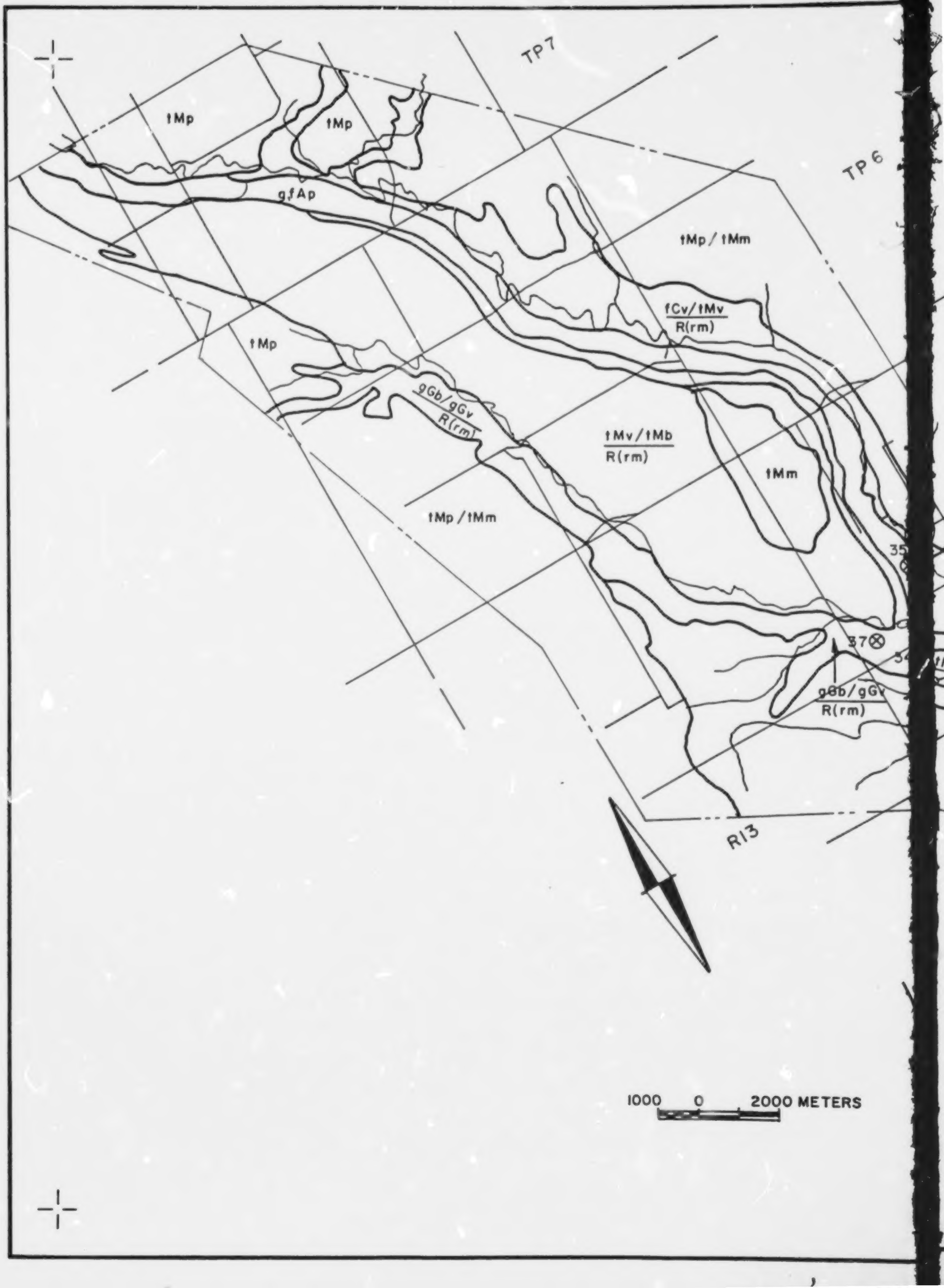
Glaciofluvial processes also created erosional and depositional landforms including glaciofluvial veneers, blankets, terraces and eskers. During deglaciation, the Souris River valley and adjacent benches were a major spillway for Glacial Lake Regina (Christiansen 1956 and 1978). Meltwater discharged along the spillway at a fairly rapid rate and locally eroded the shallow tills and soft bedrock near ground surface. As a result of this erosion, a boulder pavement may exist on some surficial tills. Sand and gravel (usually 1 m to 5 m thick) was locally deposited on the till, particularly in the vicinity of Estevan. Some sand and gravel was also deposited in the old channels of the spillway and in other meltwater channels.

Weathering of glacial deposits and near-surface bedrock has produced recent colluvial deposits, especially along river valley slopes. Recent alluvial deposits also occur along the Souris River valley.

.2 Alameda Dam and Reservoir Site

The most common glacial deposits along the Alameda Dam and Reservoir sites were deposited directly from the glacier and from meltwater associated with the advancing and retreating ice sheet (Figure 4).

Materials deposited directly from the ice consist of basal and ablation till, with intertill sands and gravels, which form moraine plain and rolling moraine landforms. Basal till generally lies beneath ablation till in these


TP7
tMp
tMp
gfAp
TP6
tMp / tMm
fCv/tMv
R(rm)
tMp
gGb/gGv
R(rm)
tMv / tMb
R(rm)
tMm
tMp / tMm
35
37
34
gGb/gGv
R(rm)
R13
1000
0
2000 METERS

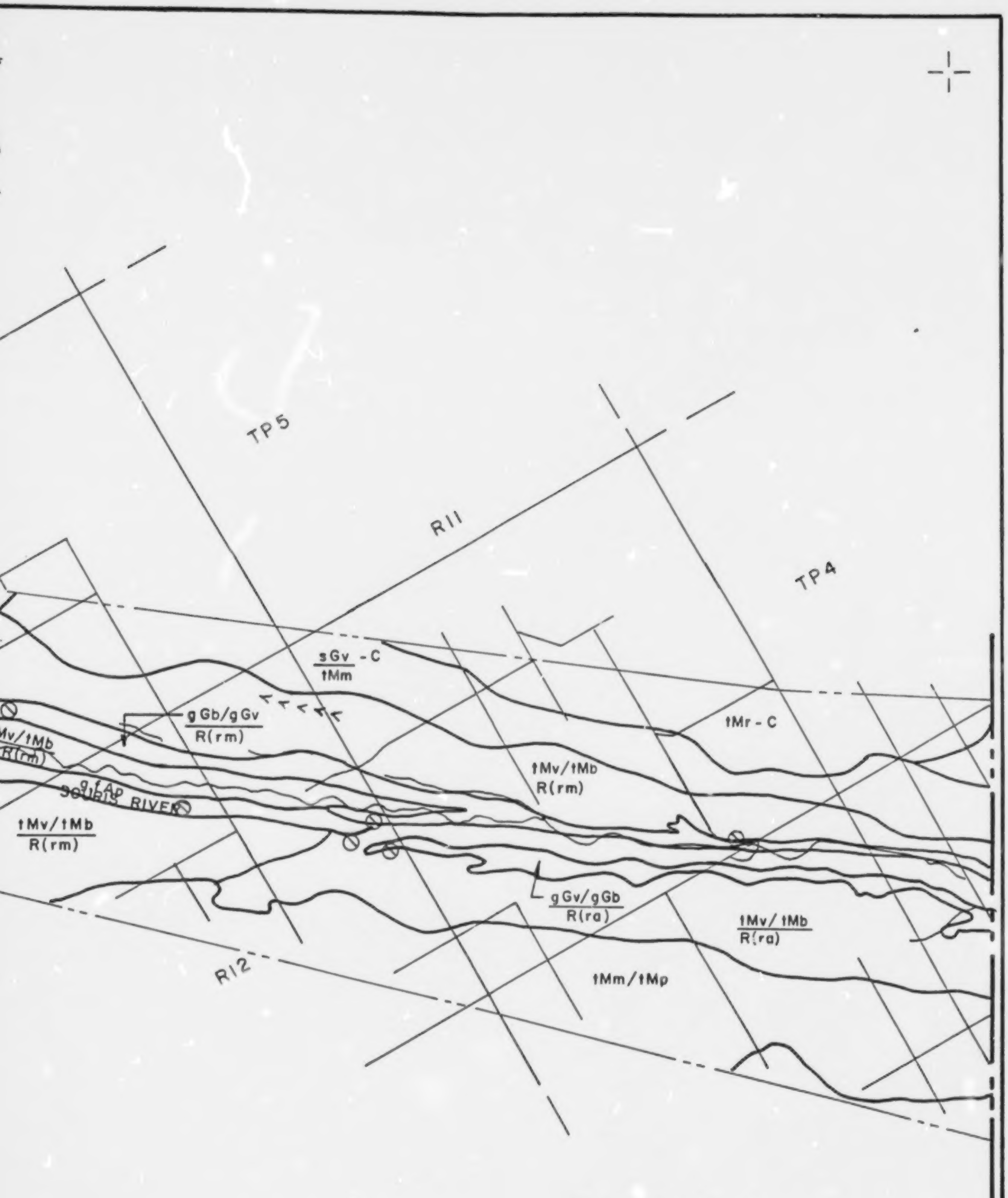
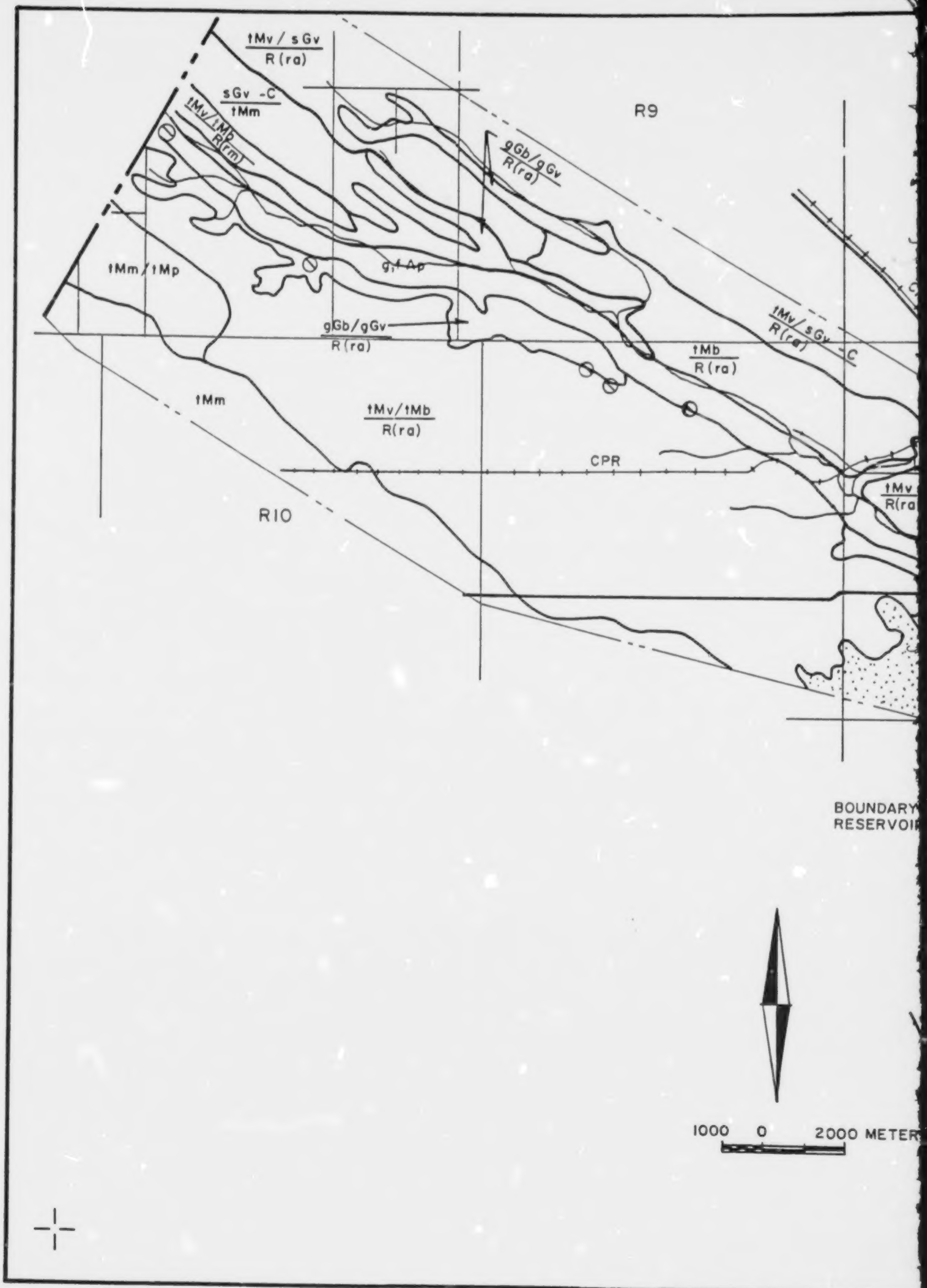

TP5
R11
TP4
sGv/tMm - C
gGb/gGv / R(rm)
Mv/tMb / R(rm)
g f Ap
SOURIS RIVER
tMv/tMb / R(rm)
tMv/tMb / R(rm)
tMr - C
gGv/gGb / R(ra)
tMv/tMb / R(ra)
R12
tMm/tMp

FIGURE 1

RAFFERTY RESERVOIR
SURFICIAL GEOLOGY
SOURIS VALLEY AREA


tMv / sGv
R (ra)
sGv -C
tMm
tMv/tMb
R(rm)
R9
gGb/gGv
R(ra)
tMm/tMp
g1 f Ap
gGb/gGv
R (ra)
tMv/sGv -C
R(ra)
tMb
R (ra)
tMm
tMv/tMb
R(ra)
CPR
tMv
R(ra
R10
BOUNDARY
RESERVOI
1000 0 2000 METER

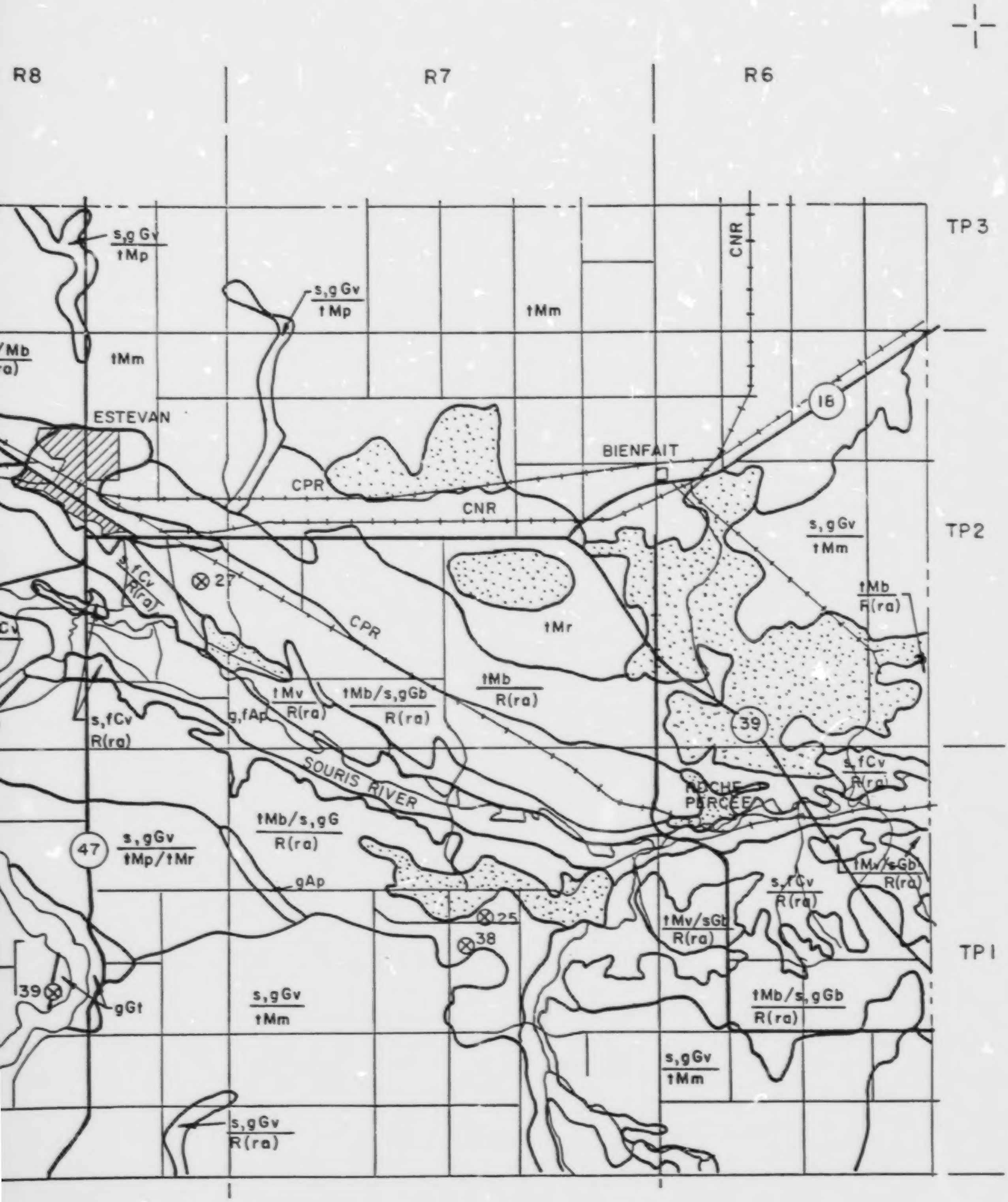

R8
R7
R6
TP3
TP2
TP1
CNR
s,g Gv
tMp
s,g Gv
tMp
tMm
/Mb
ra)
tMm
16
ESTEVAN
BIENFAIT
CPR
CNR
s,gGv
tMm
⊗27
s,fCv
R(ra)
Cv
CPR
tMr
tMb
R(ra)
tMb
R(ra)
tMv
R(ra)
tMb/s,gGb
R(ra)
g,fAp
s,fCv
R(ra)
39
SOURIS RIVER
ROCHE
PERCEE
s,fCv
R(ra)
tMb/s,gG
R(ra)
47
s,gGv
tMp/tMr
gAp
⊗25
⊗38
tMv/sGb
R(ra)
s,fCv
R(ra)
tMv/sGb
R(ra)
39⊗
gGt
s,gGv
tMm
tMb/s,gGb
R(ra)
s,gGv
tMm
s,gGv
R(ra)

FIGURE 2

RAFFERTY RESERVOIR
SURFICIAL GEOLOGY
SOURIS VALLEY AREA

Figure 3
Legend - Surficial Geology

Map Symbol	Terrain Unit	Material (Soil or Rock)	Thickness (metres)	Topography	Slope Class	Surface Drainage	Comments
			Landform Characteristics				
Ap	Alluvial Plain	Silt, Clay, Sand, Gravel	GT 5	Level to Nearly Level	1	Good to Poor	Source of granular material - existing pits in this unit
At	Alluvial Terrace	Silt, Clay, Sand, Gravel	GT 5	Level to Nearly Level	1	Good	Source of granular material
Cv	Colluvial Veneer	Silt, Clay, Sand, Gravel (usually overlies bedrock)	LT 1	Gently to Steeply Sloping (reflects underlying unit)	2-7	Good	
Cm	Colluvial Mantle	Silt, Clay, Sand, Gravel	GT 5	Gentle to Steeply Sloping	2-7	Good	
Gv	Glaciofluvial Veneer	Gravel, Sand	LT 1-1	Gently to Steeply Sloping (reflects underlying unit)	2-5	Good	
Gb	Glaciofluvial Blanket	Gravel, Sand	1-5	Level to Moderately Sloping (reflects underlying unit)	3-5	Good	Source of granular material - existing pits in this unit
Gt	Glaciofluvial Terrace	Gravel, Sand	GT 5	Level to Nearly Level	1	Good	Source of granular material - existing pits in this unit
Mv	Moraine Veneer	Till (Sandy Clay Till; Boulders where washed)	LT 1-1	Nearly Level to Moderately Sloping (reflects underlying unit)	2-5	Fair to Good	
Mb	Moraine Blanket	Till (Sandy Clay Till; Boulders where washed)	1-5	Level to Moderately Sloping	2-5	Fair to Good	
Mp	Moraine Plain	Till (Sandy Clay Till; Boulders where washed)	GT 5	Level to Gently Sloping	1-3	Fair to Good	
Mm	Rolling Moraine	Till (Sandy Clay Till; Boulders where washed)	GT 5	Nearly Level to Strongly Sloping	2-5	Fair to Good (poor in depressions)	
Mr	Ridged Moraine (oriented ridges)	Till (Sandy Clay Till; Boulders where washed)	GT 5	Nearly Level to Strongly Sloping	2-5	Fair to Good (poor in depressions)	
R(ra)	Rock-Ravenscrag Formation (Tertiary); includes some Frenchman Formation of similar lithology	Sandstone, Siltstone, Claystone, Lignite - poorly consolidated with kaolin zones, concretionary zones, and calcareous zones	-	Level	1-3	Often veneered or blanketed by glacial deposits e.g. till, colluvium, glaciofluvial materials	
R(rm)	Rock-Riding Mountain Formation (Cretaceous)	Silty Claystone and Claystone, noncalcareous and locally bentonitic	-	Level	1-3	Often veneered or blanketed by glacial deposits e.g. till, colluvium, glaciofluvial materials	

Textures

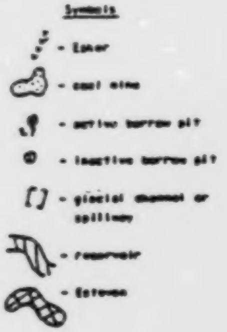
l - mixture of silt and clay
s - sand
g - gravel; some sand
t - till (sandy clay with boulders where washed)

NOTE: LT indicates less than
GT indicates greater than

Processes

C - channelled

Symbols

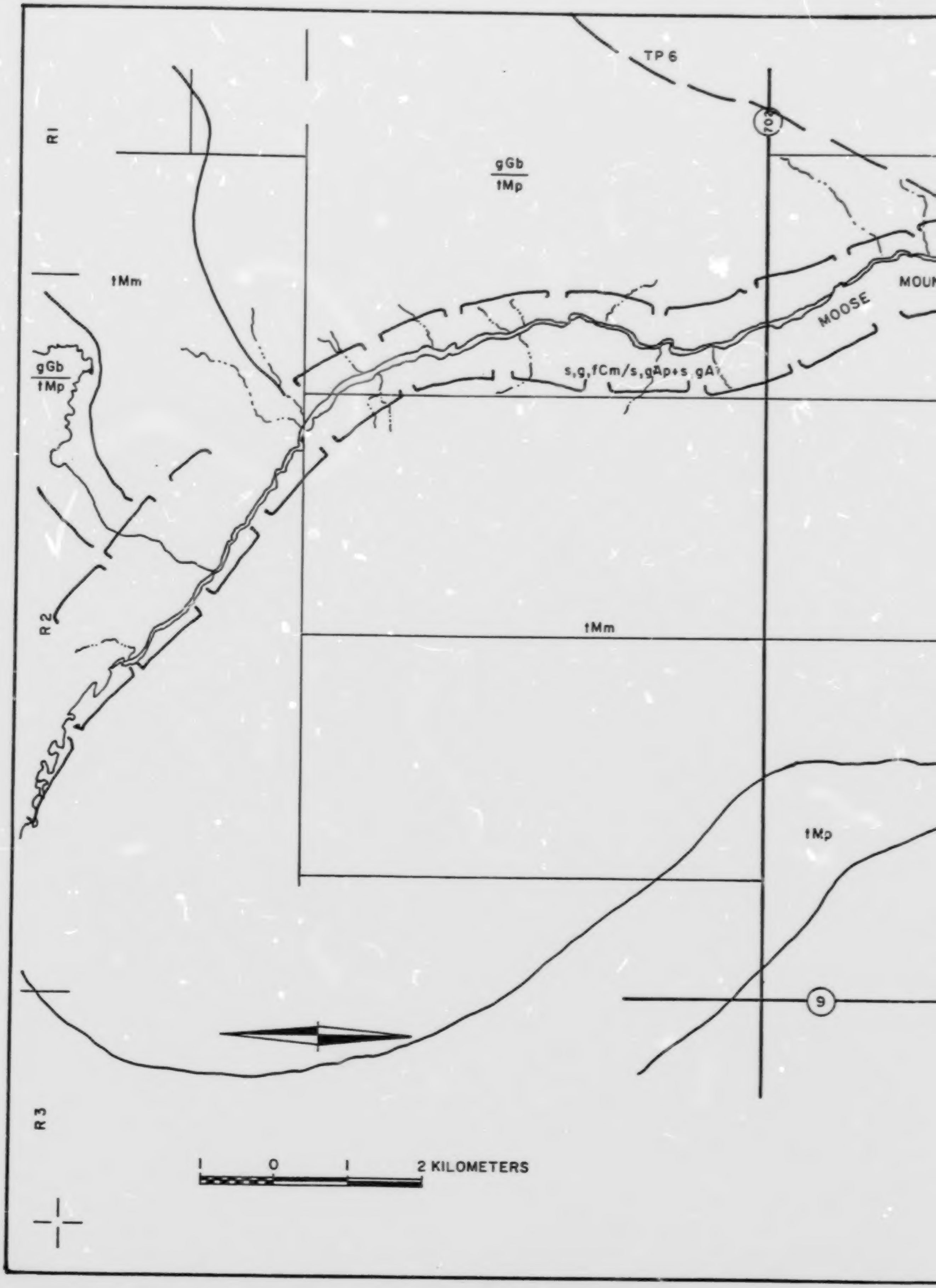


Examples

50% 50%
1. tMv - sGv - C
R(ra)

75% 25%
2. lCv / tMv
R(rm)

Slope Class	Percent	Degrees
1	0 - 0.30	0
2	0.30 - 2	0.3 - 1
3	2 - 5	1 - 3
4	6 - 9	3.3 - 5
5	10 - 15	6 - 8.3
6	16 - 30	9 17
7	31 - 45	17 - 24
8	46 - 70	25 - 35
9	71 - 99	38 - 45
10	100	45


TP 6
703
R1
gGb
tMp
tMm
gGb
tMp
s,g,fCm/s,gAp+s,gA?
MOOSE
MOUN
R2
tMm
tMp
9
R3
1 0 1 2 KILOMETERS

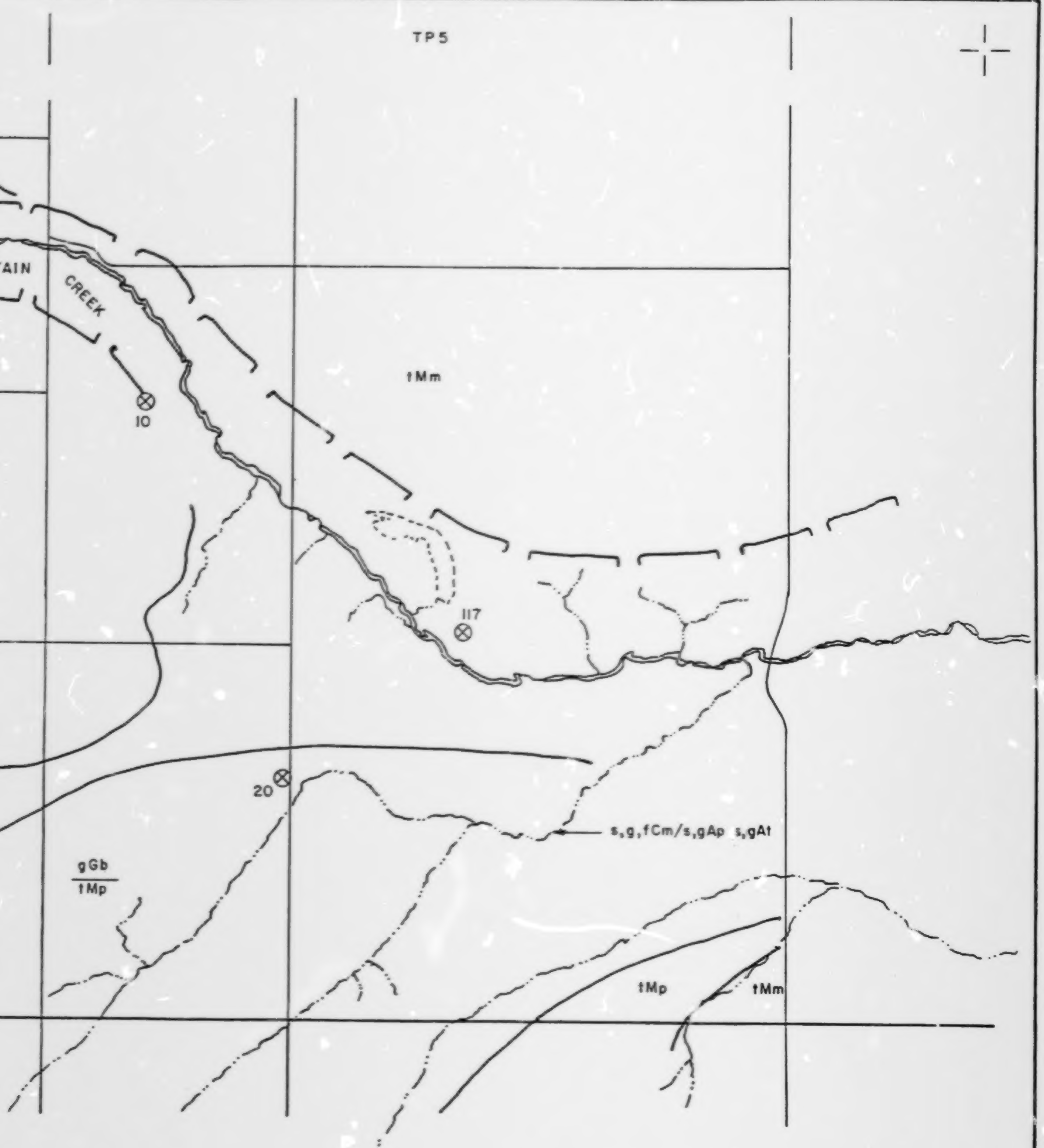

TP5
AIN
CREEK
tMm
10
117
20
s,g,fCm/s,gAp s,gAt
gGb
tMp
tMp
tMm

FIGURE 4

ALAMEDA RESERVOIR
SURFICIAL GEOLOGY OF
ALAMEDA RESERVOIR

landforms. Basal till is clayey in texture while ablation till is weakly sorted and silty to sandy (Mollard 1984). The morainal landforms which are made up of till represent the ground moraine and dead ice moraine mapped by Christiansen (1956). The depth of till found in these landforms is greater than 5 m in thickness. In the vicinity of the dam site, basal till is at least 20 m thick while surface ablation till is slightly greater than 5 m in thickness (Mollard 1984). Water well drillers' logs in and near Alameda reservoir indicate till thicknesses in the range of 40 m to 75 m.

Meltwater has also created erosional and depositional glaciofluvial landforms including meltwater channel or spillway features and outwash blanket deposits. The Moose Mountain Creek valley was the location of a major meltwater channel or spillway. Till and soft bedrock were eroded along the valley. Some sand and gravel materials were deposited along the valley of this meltwater channel and its subsidiary channels. In addition meltwater formed glaciofluvial blanket deposits 1 m to 5 m thick in upland areas along Moose Mountain Creek. These deposits overlie till in the vicinity of the east abutment of the proposed dam site (Mollard 1984).

Weathering of glacial deposits and near-surface bedrock has produced recent colluvial deposits along river valley slopes. Recent alluvial plain and terrace deposits have also formed along the Moose Mountain Creek valley.

MINERAL RESOURCES

This geological assessment area includes several economically significant deposits of sand, gravel, oil, coal and shale. The primary source of coal is the Ravenscrag Formation. Shale from the Ravenscrag Formation has been used for brick making material and shale chips for road surfacing.

.1 Coal

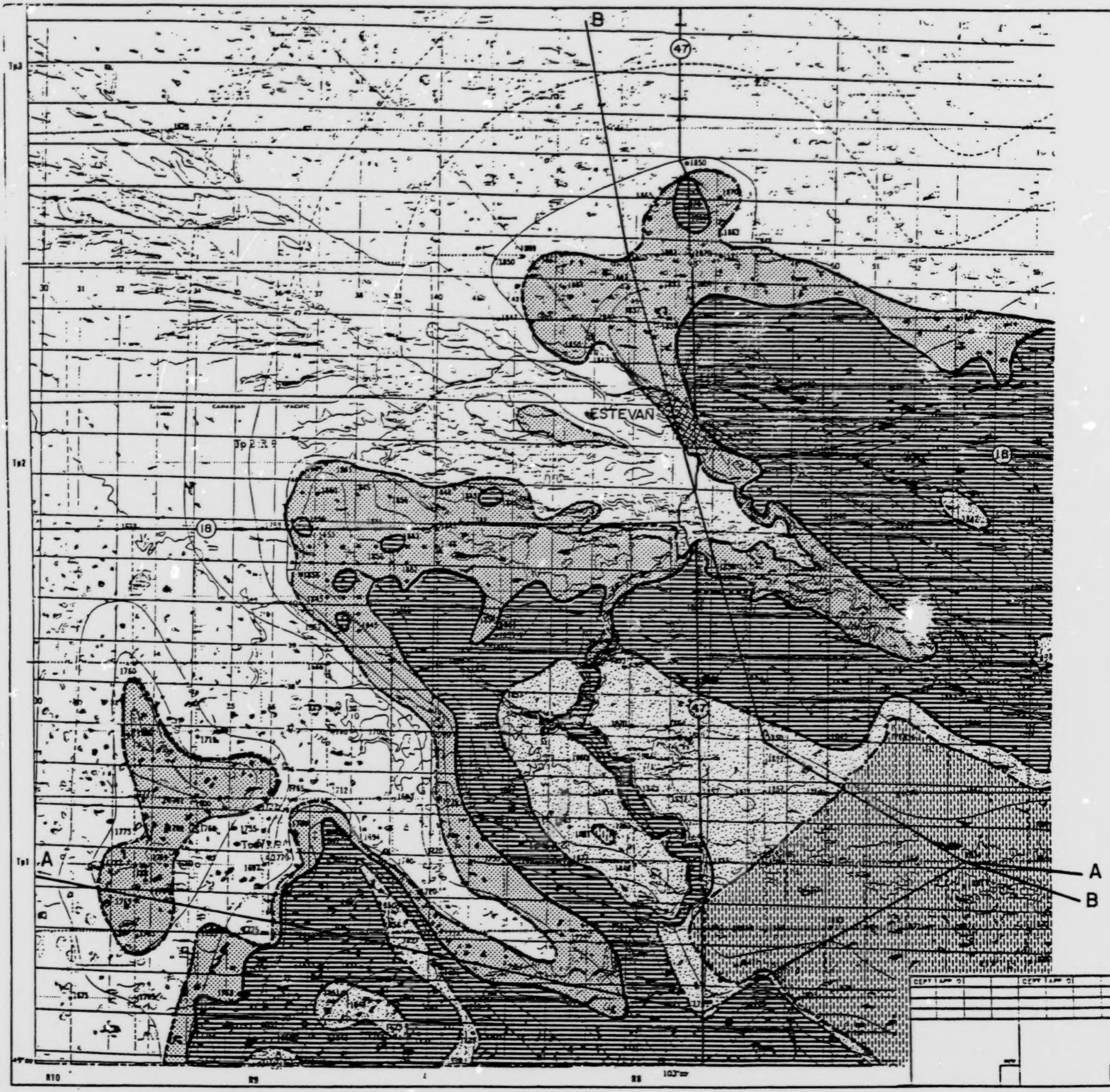
Lignite coal beds have been delineated through interpretation of drill hole and geophysical log data in the Paleocene strata of southern Saskatchewan, notably in the Tertiary Ravenscrag Formation. Nineteen coal zones have been recognized in the lignite bearing sands, silts and clays in the Estevan area. The identified coal zones of the Estevan area have been subdivided into "deep coal zones" and "shallow coal zones". Of the 19 identified coal zones, only the top 5 are considered "shallow" and potentially recoverable and of economic interest. Four of these zones outcrop in the Estevan area at places along the banks of the Souris River, Long Creek and Short Creek. Coal has been mined from most, if not all, of these zones in the past. The distribution of these five "shallow" zones is shown in the Zone Subcrop Map, Figure 5.

The sequence of strata in descending order generally comprises glacial till, preglacial gravel in some places, Ravenscrag Formation, Frenchman Formation and Bearpaw Formation. The thickness of these formations varies throughout the map area. Over a large area, glacial and preglacial erosion have removed all strata except the Bearpaw Formation. Southeast of Roche Percee approximately 305 metres (1,000 feet) of Ravenscrag Formation overlie approximately 24 metres (80 feet) of Frenchman Formation on top of the Bearpaw Formation.

The regional structure of the Estevan area is a syncline gently plunging to the southeast at approximately 4.7 m/km (25 feet per mile). Coal zones of the Ravenscrag Formation conform to this regional structure. The intersection of the plunging coal zones and the bedrock surface results in the subcrop patterns of Figure 5. The Boundary zone extends farther to the north and west, nearer the Rafferty Dam and Reservoir than stratigraphically higher zones. The Short Creek zone, at the top, occur only in Township 1, Ranges 5 and 6.

Stratigraphic relationships in the area near Estevan are shown by the two intersecting cross-sections, A-A^1 and B-B^1 in Figure 6. The proposed Boundary to Rafferty diversion channel overlies the most westerly portions of the Souris, Estevan and Boundary zones. The channel will pass through the mine spoils between Highway 18 and Boundary Reservoir, where economically recoverable seams have already been removed. Coal seams in the Boundary Zone, which underly a portion of the proposed channel north of Highway 18, are generally thin, splitting and interbedded with fine-grained strata.

In the diversion channel area, the net coal thickness of the Boundary Zone has been estimated to vary between 1.5 and 2 metres (see Figure 7). At current coal values and with extensive and better alternatives for coal mining in the region, it is considered that all economic coal in this area has been extracted. As shown in Figure 7, the net thickness of the coal in the Estevan Zone was in the order of 1.5 to 1.8 metres with overburden varying from 15 to



ZONE SUBCROP MAP

(ESTEVAN AREA)

Scale 1:100.000

Kilometres 2 0 2 4 6

Miles 1 0 1 2 3

▩	Short Creek Zone
▥	Roche Percee Zone
░	Souris Zone
☰	Estevan Zone
▒	Boundary Zone

Line of section .... B B'

Bedrock structure contours (interval 50 feet) 1800

Elevation of bedrock (in feet) 1694

Bedrock surface not reached by drill 1765

SOURCE: ADAPTED FROM PLATE 7 - COAL RESOURCES
OF SOUTHERN SASKATCHEWAN: A MODEL
FOR EVALUATION METHODOLOGY 1978

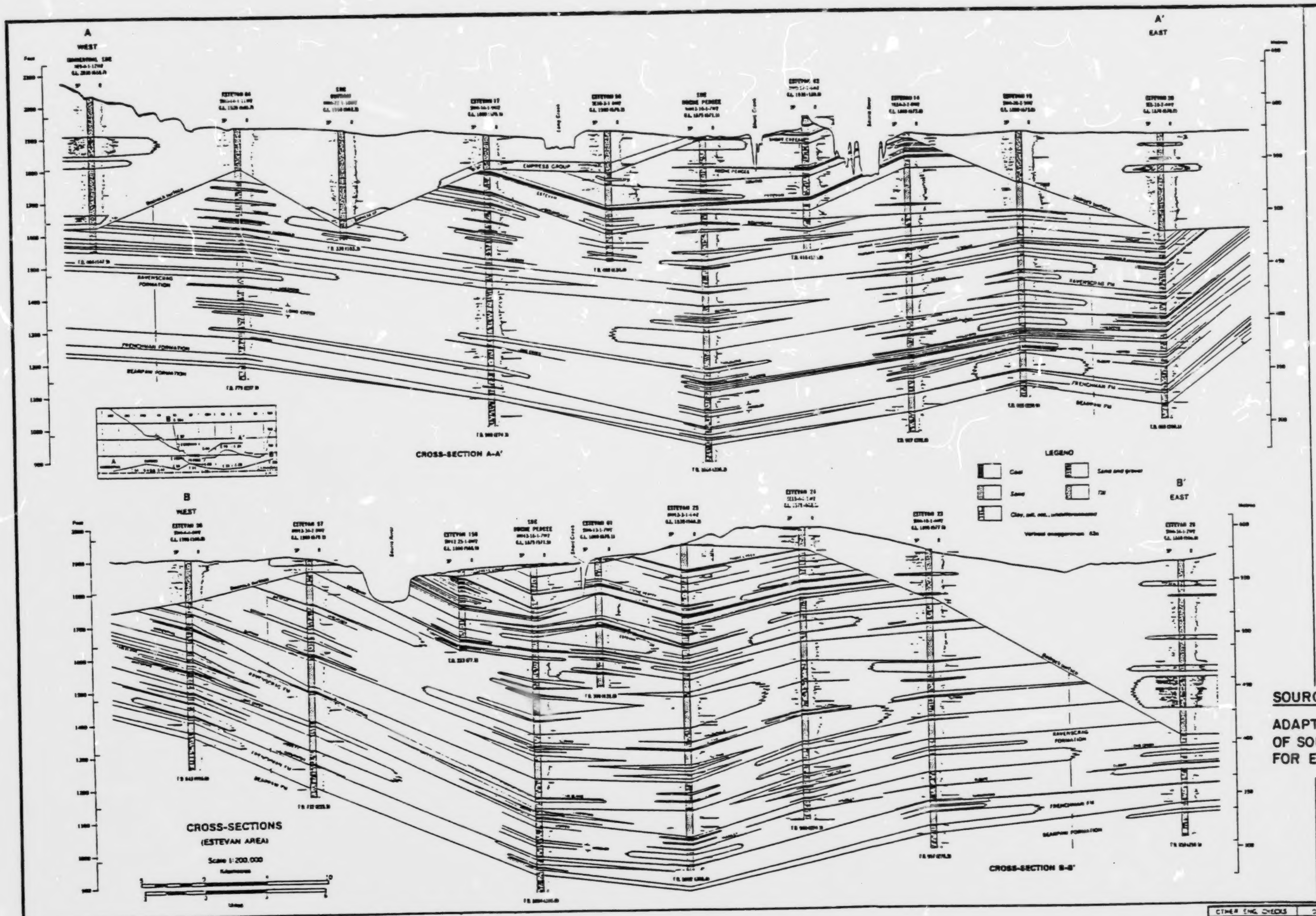
FIGURE 5

SOURIS BASIN DEVELOPMENT AUTHORITY
RAFFERTY / ALAMEDA PROJECTS

RAFFERTY DAM
RESERVOIR
ENVIRONMENTAL IMPACT STATEMENT
COAL ZONE SUBCROP MAP
ESTEVAN AREA

OTHER ENG. CHECKS
DRAFTING DEPT
DESIGN DIVISION

A A41315 11410 RIVIR A


A
WEST
A'
EAST
EMPRESS GROUP
RAVENSCRAG FORMATION
FRENCHMAN FORMATION
BEARPAW FORMATION
RAVENSCRAG FM
FRENCHMAN FM
BEARPAW FM
ROCHE PERCEE
Long Creek
Short Creek
Souris River
CROSS-SECTION A-A'
LEGEND
Coal
Sand
Sand and gravel
Till
Clay, silt, etc., undifferentiated
B
WEST
B'
EAST
CROSS-SECTION B-B'

CROSS-SECTIONS
(ESTEVAN AREA)
Scale 1:200,000

SOURCE:

ADAPTED FROM PLATE 7- COAL RESOURCES OF SOUTHERN SASKATCHEWAN : A MODEL FOR EVALUATION METHODOLOGY 1978

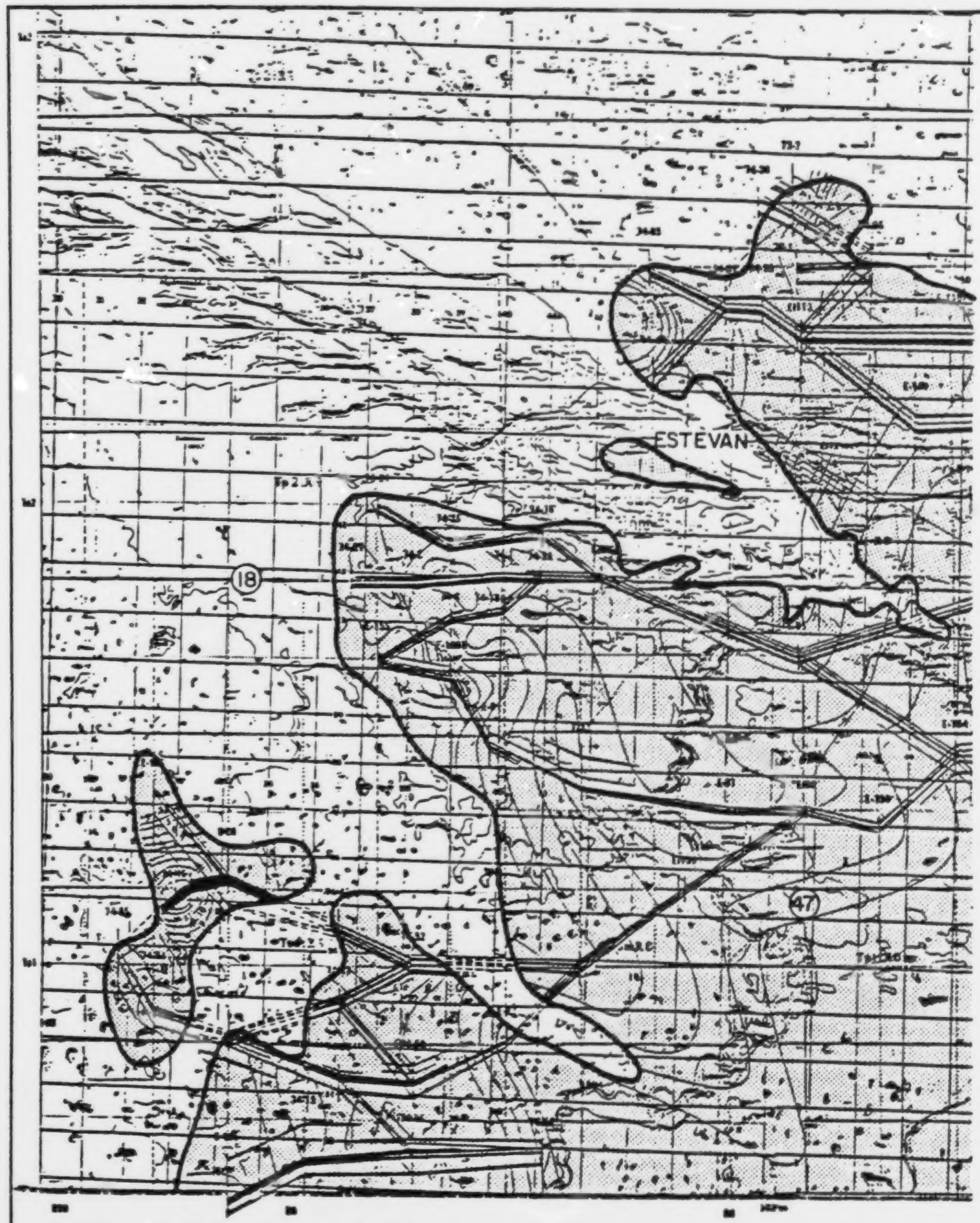
FIGURE 6

SOURIS BASIN DEVELOPMENT AUTHORITY
RAFFERTY / ALAMEDA PROJECTS

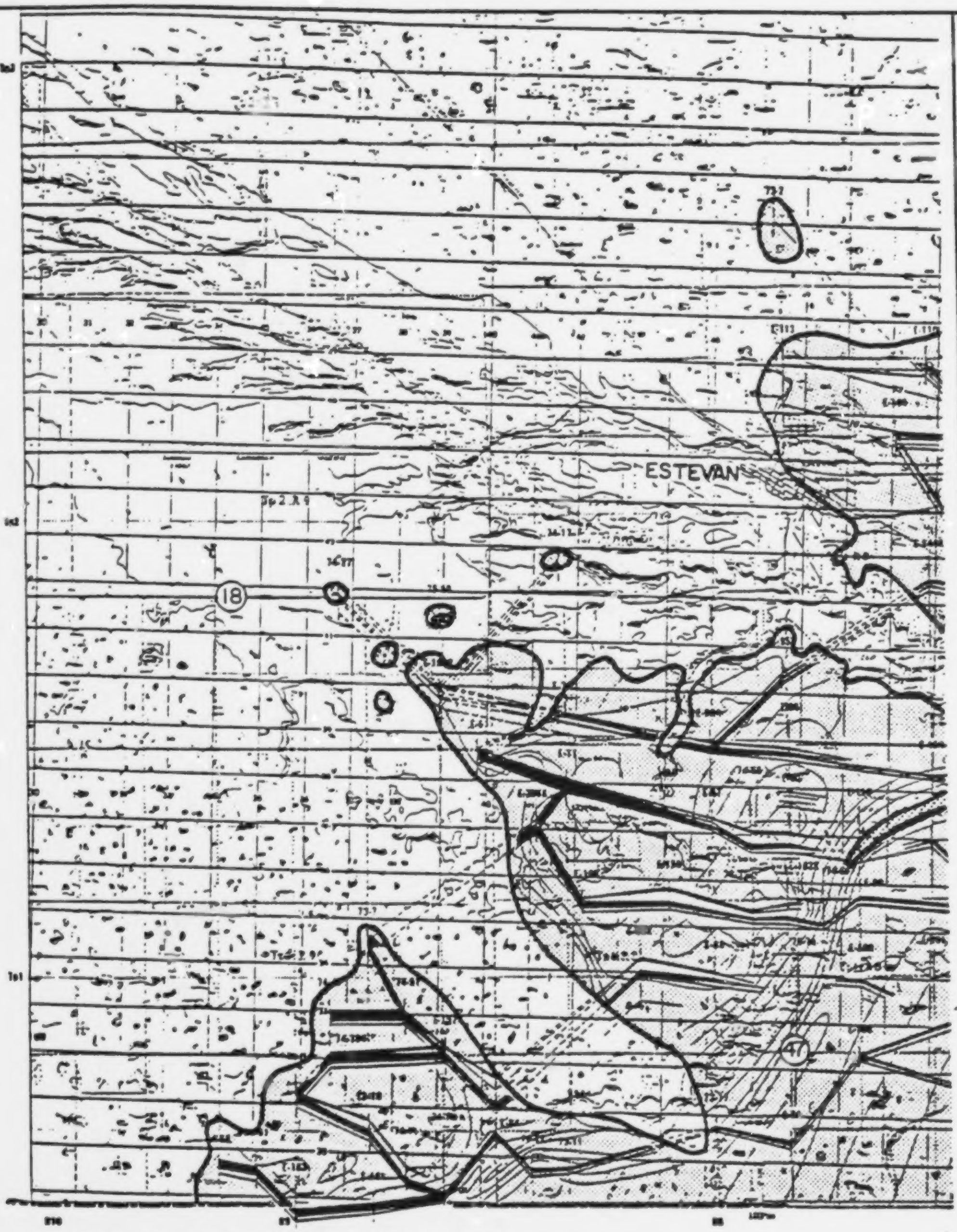
RAFFERTY DAM
RESERVOIR
ENVIRONMENTAL IMPACT STATEMENT
CROSS-SECTIONS
ESTEVAN AREA

A4351 1140 RVR A

OTHER ENG. CHECKS
DRAFTING DEPT
DESIGN DIVISION


ESTEVAN
18
47

SOURCE: ADAPTED FROM PLATE 9 – COAL
RESOURCES OF SOUTHERN SASKATCHEWAN:
A MODEL FOR EVALUATION METHODOLOGY 1978

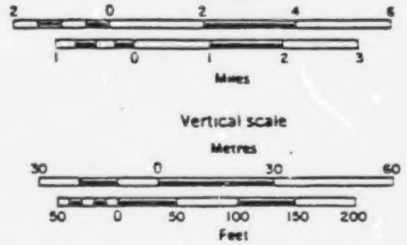

ESTEVAN
18
47

SOURCE: ADAPTED FROM PLATE 11 – COAL
RESOURCES OF SOUTHERN SASKATCHEWAN:
A MODEL FOR EVALUATION METHODOLOGY 1978

FENCE DIAGRAM OF THE ESTEVAN ZONE

(ESTEVAN ZONE)

Scale 1:133,333


Kilometres
2
0
2
4
6
1
0
1
2
3
Miles
Vertical scale
Metres
30
0
30
60
50
0
50
100
150
200
Feet

Area of zone .... ▨

Area of sand occurring stratigraphically equivalent to zone .... ▨

Isopach of net coal (interval 2 feet) .... ═10═

Note 1: Area affected by ice thrusting, insufficient data to completely evaluate the extent and degree of disturbance

FIGURE 7

SOURIS BASIN DEVELOPMENT AUTHORITY

RAFFERTY / ALAMEDA PROJECTS

RAFFERTY DAM
RESERVOIR
ENVIRONMENTAL IMPACT STATEMENT
COAL: ESTEVAN ZONE

OTHER ENG. CHECKS
DRAFTING DEPT
DESIGN DIVISION

A4315 | 1140 | RVR | A

30 metres throughout the majority of the proposed channel route (Figure 8). This zone and the overlying Souris zone have already been mined.

Figure 9 indicates the limits of the Boundary, Estevan and Souris lignite coal seams in the Diversion channel area together with the limits of the mined out areas (SPC 1987). As illustrated in the various figures, there are no other lignite coal resources in the immediate Rafferty Project Area or the Alameda Project Area. Accordingly, no mitigative action is required by the Authority.

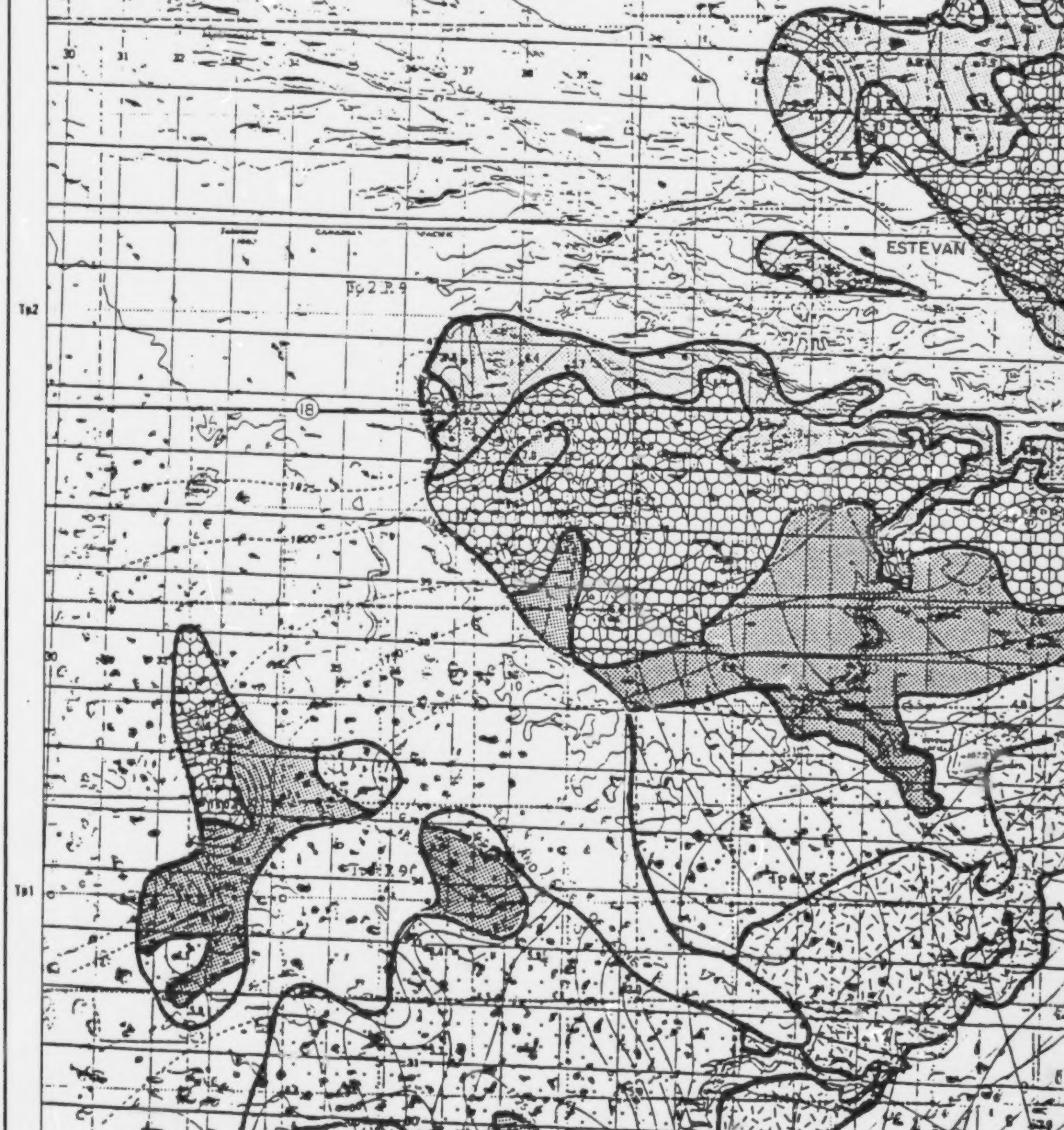
.2 Sand and Gravel

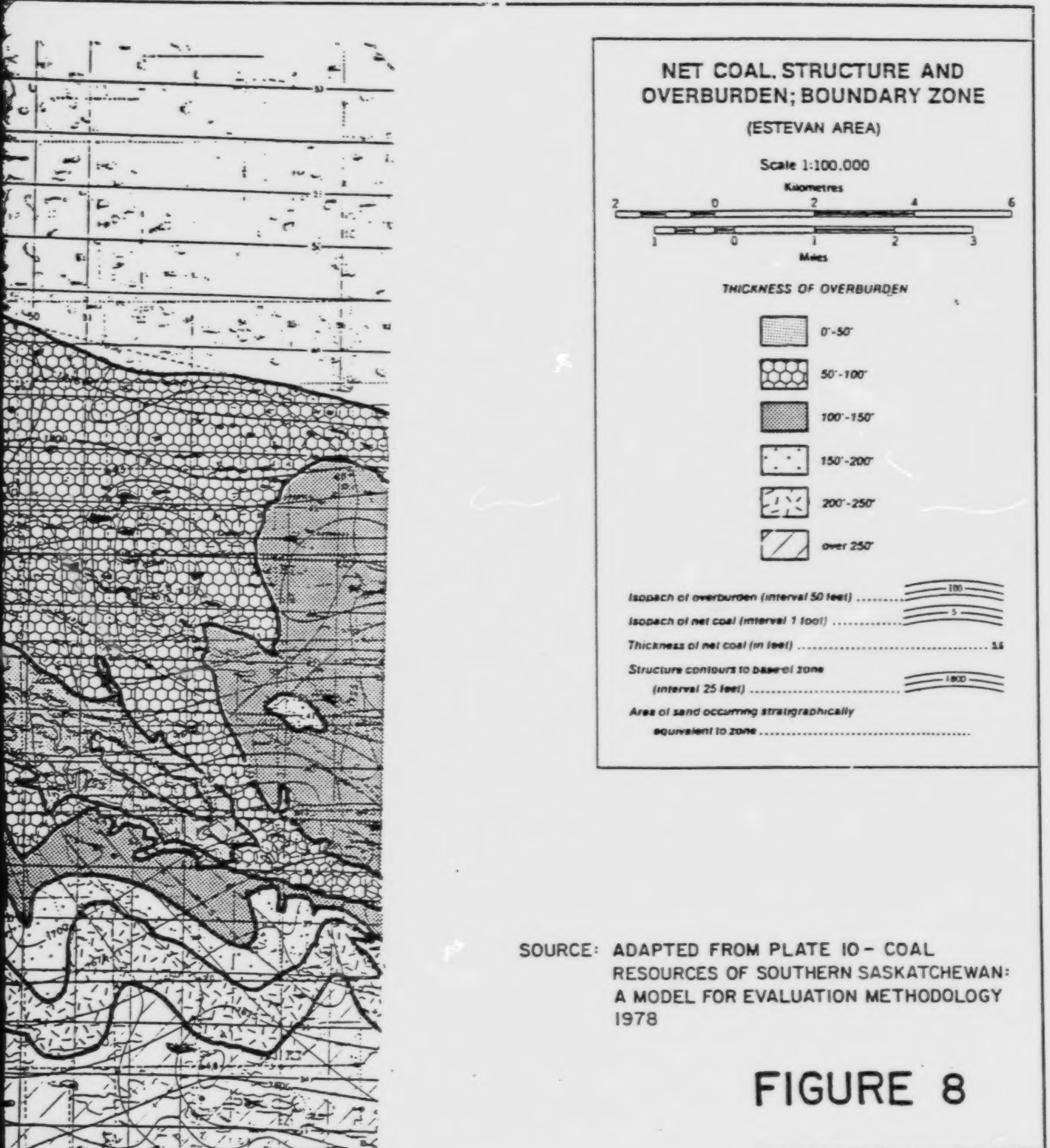
Introduction

In addressing the impact of the Rafferty and Alameda Reservoirs on mineral resources, the Souris Basin Development Authority has identified granular deposits within the Rafferty Reservoir area and has assessed the quantity, quality and salvage costs of the deposits prior to flooding. A copy of the detailed report is included in this section of the Environmental Impact Statement as Appendix 1. The results of the Alameda field work will be submitted to Saskatchewan Environment when the investigations and report are complete.

Methodology

Methodology employed included site reconnaissance, reviewing of available document information and field investigations. Site reconnaissance was undertaken to gain a ground level appreciation for the area of study and to visually examine previously identified potential sites having the greatest probability of containing granular material. The area of study is defined as an area between lines running east-west of Halbrite and the Canada-U.S. border. The area is bordered on the west by a line extending north-south through Bromhead and on the east by a line extending north-south through Estevan. Discussions were also held with representatives of local contracting firms, local land owners, officials of area municipalities and Saskatchewan Highways and Transportation (SHT) to identify potential aggregate sources. In reviewing the available document information, various map series, aerial photographs, SHT pit information and a number of reports prepared on previous gravel searches in


Tp3
Tp2
Tp1
ESTEVAN
Tp.2 R.9
18
R10
R9
R8
103°W


NET COAL, STRUCTURE AND OVERBURDEN; BOUNDARY ZONE
(ESTEVAN AREA)
Scale 1:100,000
Kilometres
2 0 2 4 6
1 0 1 2 3
Miles
THICKNESS OF OVERBURDEN
0'-50'
50'-100'
100'-150'
150'-200'
200'-250'
over 250'
Isopach of overburden (interval 50 feet)
100
Isopach of net coal (interval 1 foot)
5
Thickness of net coal (in feet)
5.5
Structure contours to base of zone (interval 25 feet)
1800
Area of sand occurring stratigraphically equivalent to zone
50
1800
1700
1525

SOURCE: ADAPTED FROM PLATE 10 - COAL RESOURCES OF SOUTHERN SASKATCHEWAN: A MODEL FOR EVALUATION METHODOLOGY 1978

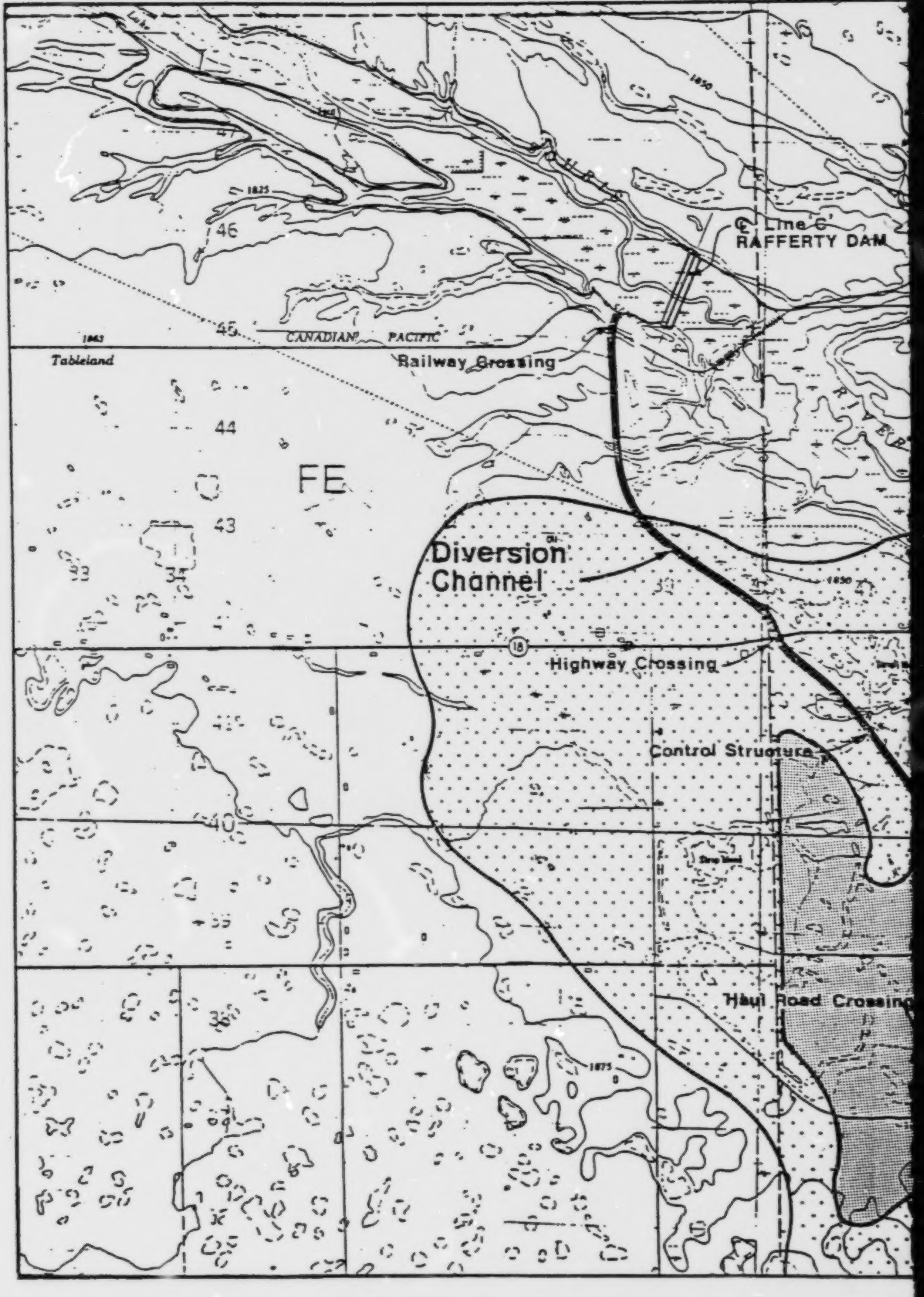
FIGURE 8

SOURIS BASIN DEVELOPMENT AUTHORITY

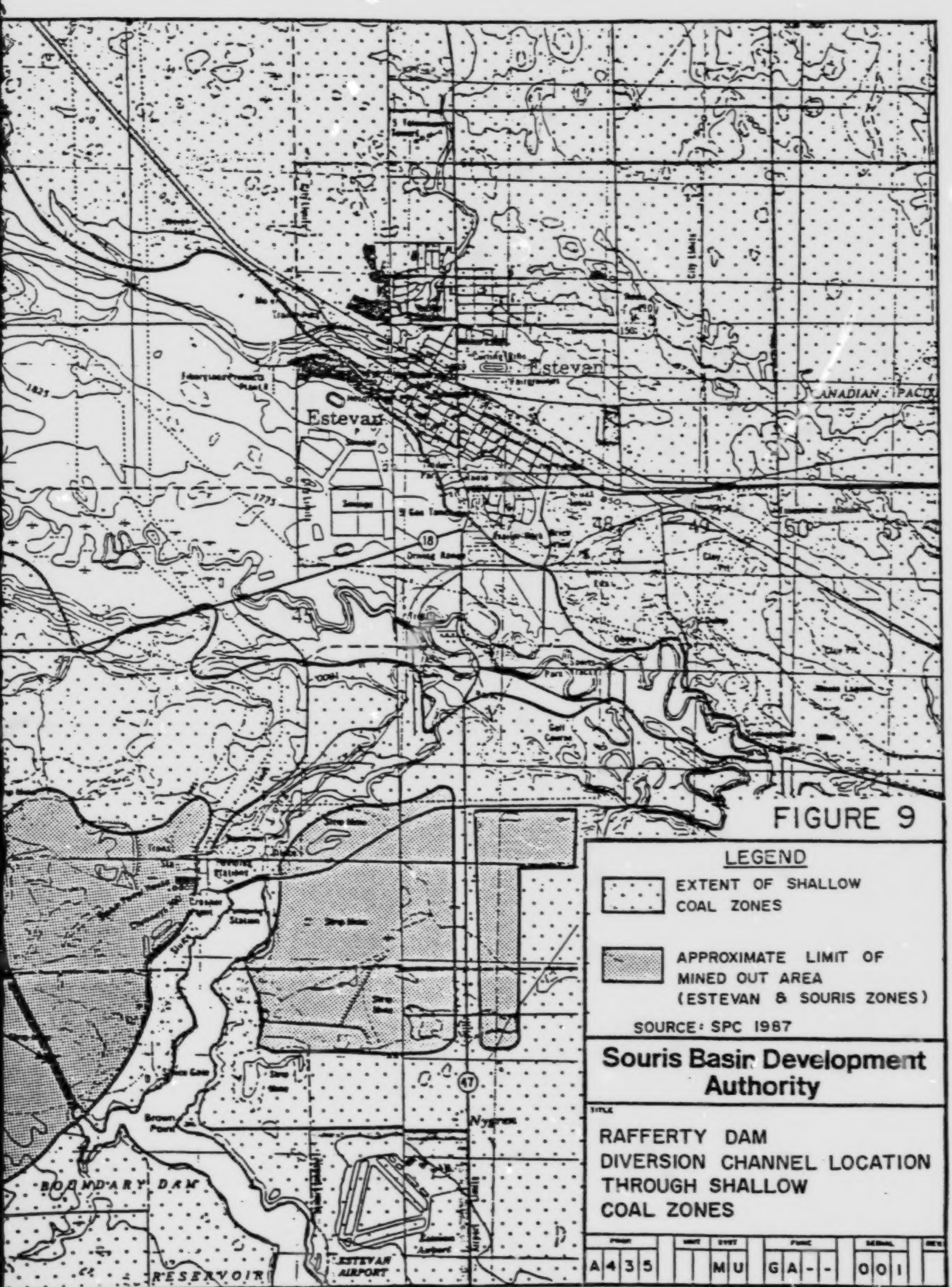
RAFFERTY / ALAMEDA PROJECTS

RAFFERTY DAM
RESERVOIR
ENVIRONMENTAL IMPACT STATEMENT
COAL: BOUNDARY ZONE

A435 1140 RIVIR A



Lake
℄ Line 'C'
RAFFERTY DAM
RIVER
1850
1825
46
45
CANADIAN PACIFIC
1863
Tableland
Railway Crossing
44
FE
43
33
34
Diversion Channel
18
Highway Crossing
Control Structure
40
39
38
Haul Road Crossing
1875



Estevan
Estevan
CANADIAN PACIFIC
18
45
47
48
49
50
Nygren
Brown Point
BOUNDARY DAM
RESERVOIR
ESTEVAN AIRPORT
City Limits
Clay Pit
Strip Mine
Golf Course

FIGURE 9

LEGEND

⁘	EXTENT OF SHALLOW COAL ZONES
▨	APPROXIMATE LIMIT OF MINED OUT AREA (ESTEVAN & SOURIS ZONES)

SOURCE: SPC 1987

Souris Basin Development Authority

TITLE

RAFFERTY DAM
DIVERSION CHANNEL LOCATION
THROUGH SHALLOW
COAL ZONES

A435 MU GA-- 001

the area were analyzed. Based on the above sources, field investigations of nine areas were undertaken in the proposed Rafferty Reservoir area of study.

Evaluation Results

The evaluation for granular resources within the proposed Rafferty Reservoir for purposes of this investigation was primarily directed toward deposits of gravel and/or cobbles and boulders that were considered to be of value. Deposits of sand were not considered to be of particular importance due to the extensive abundance of sand deposits in the general area. Coarse gravel deposits and deposits with a large percentage of cobbles and boulders, suitable for crushing high quality aggregate, did not appear to be abundant in the specific Study Area. Known deposits in the general assessment are shown on Figure 5. Outwash plains and outwash stream deposits provided the most important sources of good quality granular material however, the Souris River Valley is not part of an outwash plain nor do significant outwash stream deposits appear to exist. Granular deposits in the valley bottom tended to be scattered and of limited lateral extent and depth. No granular material could be identified in the numerous exposed old test pits observed during the field reconnaissance. This was confirmed throughout the proposed Reservoir area.

The area below Weyburn is known to have been searched for granular sources with little or no success. Consequently, Weyburn area users of aggregate rely on sources outside the Souris River Valley. Users of aggregate within the general Study Area make little use of the limited sources in the Souris River Valley.

The lateral extent of the gravel deposits and depth of the deposits was determined in the field by means of drilling test holes, excavating test pits and visual examination. Only one site revealed a source of limited local significance. As it contained large shale inclusions, it was deemed to be of little commercial value and not of further interest to this assessment.

The assessment area on the whole contained few granular deposits of value and, in particular, deposits of gravel or rock suitable for crushing are scarce. The majority of sources have been worked extensively or exist as active pits. In the active pits, the bulk of the gravel that forms part of the deposits has been mined to depletion or near depletion with the exception of SHT Pit 62#-141. A site plan of this pit, and the logs and laboratory analysis conducted, is presented in the Appendix. An investigation of the area adjacent to this pit indicated that the limits of the pit have been well defined.

Some potential sites are below the existing water table and, at this point, recovery is not considered to be economic. Similarly, other deposits may be situated in areas where overburden is excessive and cost of recovery is greater than the value of the product. Based on the results of this investigation, and other available data, it appears that SHT Pit 62#-141 is the only economically recoverable gravel source in the specific area of concern.

Mitigation

The Authority anticipates that the majority of the gravel at SHT Pit 62#-141 will be required in the construction of the Rafferty Dam. Should there be additional material available after the Dam has been completed, it will be extracted and stockpiled at a location some distance from the reservoir.

The material stockpiled will be of coarse granular sizes with low silt content. As such, it will not be readily eroded from the stockpiles during high precipitation events. There will be no potential for sheet erosion introducing sediment loads into the reservoir or the Souris River downstream. Further, as described in the Fisheries section, good construction practices and mitigation measures will be in place in order minimize construction induced sedimentation of the river.

.3 Oil

Introduction

Townships 5, 6 and 7 along the Souris river valley are active areas for the production of medium gravity crude oil from the Weyburn Frobisher Beds Pool and the Weyburn Midale Beds Pool as indicated on the Petroleum and Natural Gas Disposition Map, Saskatchewan Energy and Mines (1987). Oil, gas and other wells such as water source, injection and disposal are indicated on this map.

Preliminary assessment of oil and gas resources in the Project Area undertaken for the Saskatchewan Power Corporation in 1985 has been augmented by studies initiated by the Souris Basin Development Authority. The preliminary work identified oilfield facilities likely to be affected and included contact with producers and pipeline companies holding interests in the area.

Subsequent work on behalf of the Authority further defined the specific facilities at both the Rafferty and Alameda sites and developed the strategic plan for ensuring that project impact upon the resource is effectively mitigated and disruption to operations and resource management is minimized.

Most of the existing facilities affected are at the Rafferty site; considerably less impact upon oilfield activities will occur at the Alameda site. The 1987 decision to move the Rafferty Dam site had major benefits in terms of offsetting impact upon the industry and the resource. The new site, with a correspondingly adjusted area of inundation, results in a substantially diminished number of affected facilities relative to that initially envisioned in 1985. In addition, the Authority has developed an operating strategy which will further reduce the impact of the reservoir on the oilfield facilities in the Weyburn Unit. The Rafferty Reservoir will be operated at an Initial Operating Level (IOL) of 549.5 m for a period currently estimated at 20 - 25 years to allow for an orderly depletion of the existing oil wells given current technology.

Oil Field Mitigation

The decisions to move the Rafferty Dam from Site "A" to Site "C" and to operate the Reservoir at an Initial Operating Level (IOL) of 549.5 m has reduced the impact on approximately 20 wells with a significant reduction in oilfield mitigation costs.

Using the new criteria of an IOL of 549.5 m, reduction in oilfield mitigation costs were calculated and the resulting "cost reductions" were found to be in the order of $13.3 million less than the initial oil mitigation estimate of $32.1 million. This results in an estimated net cost of oilfield mitigation of $18.8 million in 1986 dollars. This figure, an approximate reduction in mitigation cost of 41 percent, does not include the costs of moving powerlines or elevating municipal roads.

Reservoir elevations at FSL 550.5 m, Initial Operating Level of 549.5 m, and Flood Control Elevation of 554.0 m are the basis for the mitigation classification of the oil field facilities described below:

Category A - Any wells or oilfield facilities at an elevation less than 547.5 m will be relocated, directionally drilled or purchased by the Authority.

Category B - Any wells or oilfield facilities at elevations between 547.5 m and 550.0 m will be diked and rip-rapped and the well head, pad and access road will be built up (elevated). The well will be "flood proofed" as required. (See Flood Proofing Criteria below.)

Category C - Any wells or oilfield facilities at elevations between 550.0 m and 554.0 m will be flood proofed as required and containment dikes will be constructed.

Upon ratification of this oilwell mitigation policy and the procedures therein, the Souris Basin Development Authority will enter into bilateral discussions with each affected oil company. It is envisaged that negotiations between the Authority and the oil companies shall commence immediately upon project approval from Saskatchewan Environment.

.1 STANDARDS FOR MITIGATION OF PROJECT IMPACT ON OILFIELD FACILITIES

A. Oilwells, Pressure Maintenance Wells, Salt Water Disposal Wells and Abandoned Wells

i) All existing wells at elevations lower than 2 m below Initial Operating Level (IOL) (549.5 m) on the Rafferty Reservoir and Full Supply Level (574.0 m) on the Alameda Reservoir shall be abandoned. The following procedures shall constitute minimum abandonment requirements and shall be paid for by the Authority:

a) set a cast iron retainer immediately above the highest perforated interval or open hole and squeeze cement into the fluid bearing formation until a pressure that is satisfactory to Saskatchewan Energy & Mines is obtained, which would indicate proper shut off;

b) fill the casing with drilling mud;

c) cut the casing off a minimum of 16 m below the surface casing shoe;

    - d) run a cement plug from 16 m below to a minimum of 16 m above the surface casing shoe;
    - e) test the plug for proper shut-off;
    - f) cut the surface casing off 1 m below ground level and weld on a steel plate;

ii) All previously abandoned wells at elevations below the Initial Operating Level that have production casing in the hole shall be re-entered, if necessary, and abandoned in accordance with clauses b) to f) in Section A.i) above.

iii) Existing wells at elevations between 2 m below the Initial Operating Level and 0.5 m above the Initial Operating Level on the Rafferty Reservoir and between 2 m below the Full Supply Level and 0.5 m above the Full Supply Level on the Alameda Reservoir shall be treated as follows:

- a) if, in the opinion of the Saskatchewan Energy and Mines, the well is situated such that it would protrude a significant distance into the reservoir at Initial Operating Level on the Rafferty Reservoir or Full Supply Level on the Alameda Reservoir the well shall be abandoned in accordance with the provision of section A.i);
- b) if the well is situated such that it would not protrude a significant distance into the reservoir at Initial Operating Level on the Rafferty Reservoir or Full Supply Level on the Alameda Reservoir, the well will be permitted to remain in place. However, the wellsite and wellhead shall be elevated to an elevation of a minimum of 0.5 m above the Initial Operating Level on the Rafferty Reservoir or Full Supply Level on the Alameda Reservoir. The well pad shall have a dike constructed around it to a minimum height of 1.5 m. The dike shall be capable of containing an amount of fluid equal to 4 days of the well's production or injection and the dike shall be rip-rapped to prevent water erosion. As an

alternative to diking water injection wells, automatic shut-down controls may be installed to prevent spills at the wellhead.

iv) All existing wells at elevations between 0.5 m above the Initial Operating Level (549.5 m) on the Rafferty Reservoir or the Full Supply Level (574.0 m) on the Alameda Reservoir and the Flood Control Level shall have dikes constructed around them. The dike shall have a minimum height of 1.5 m, be capable of containing an amount of fluid equal to 4 days of the well's production or injection and shall be rip-rapped to prevent water erosion. As an alternative, automatic shut-down controls may be installed on water injection wells to prevent spills at the wellhead.

v) All replacement wells or future infill wells to be located under the area enclosed by the Flood Control Level boundary shall be directionally drilled from a location with a surface elevation above the Flood Control Level and a minimum distance of 76 m from the area enclosed by the Flood Control Level. If the resulting surface location creates excessive deviation. In the Directional Drilling, consideration will be given to moving the surface location closer to the reservoir flood area.

vi) All existing wells located adjacent to the area bounded by the Flood Control Level and situated such that a spill or leak could reach the reservoir (spill sensitive area) shall be surrounded by a dike capable of containing a volume of fluids equivalent to 2 days production or injection. As an alternative, the well can be equipped with automatic shut-down controls.

B. Individual and Group Flowlines, Trunklines and Injection Lines

i) All existing lines carrying oil or water in the area bounded by the Initial Operating Level on the Rafferty

Reservoir or the Full Supply Level on the Alameda Reservoir shall be abandoned in accordance with the following and shall be paid for by the Authority:

a) flush the line to remove all oil and salt water;

b) cut the lines at or above the point where the lines cross the Flood Control Level boundary;

c) weld steel caps on he ends of the lines;

ii) All previously abandoned or suspended oil or emulsion lines in the area bounded by the Initial Operating Level on the Rafferty Reservoir or the Full Supply Level on the Alameda Reservoir shall be abandoned in accordance with Section B.i) above, if they have not been abandoned in accordance with these provisions.

iii) All existing natural gas flowlines in the reservoir areas will be allowed to continue to operate without modification.

iv) All existing oil and water lines in the area between the Initial Operating Level on the Rafferty Reservoir or the Full Supply Level on the Alameda Reservoir and the Flood Control Level and in the spill sensitive area shall be treated as follows;

a) oil and emulsion lines that were installed prior to 1977 shall be replaced with new lines that are either externally wrapped and internally coated or constructed of fibreglass;

b) water injection lines that were installed prior to 1982 shall be replaced with new steel lines that are externally wrapped and internally coated;

c) any other lines that are not externally wrapped, internally coated or constructed of fibreglass shall be replaced with lines that are;

d) all other lines shall be pressure tested in place and will be allowed to continue to operate if the test results are satisfactory. The minimum test pressure shall be the greater of 700 kilopascals or 1.25 times the maximum operating pressure of the line and the duration of the test shall be 24 hours.

C. Batteries, Satellites and Water Injection Stations

i) Any battery, satellite or water injection station located at an elevation below the Initial Operating Level on the Rafferty Reservoir or the Full Supply Level on the Alameda Reservoir shall be abandoned, all above ground facilities shall be removed and the site shall be restored. If a replacement facility is necessary, it must be relocated at a site with an elevation above the Flood Control Level and a minimum distance of 76 m from the area enclosed by the Flood Control Level.

ii) Any battery, satellite or water injection station located at an elevation between the Initial Operating Level on the Rafferty Reservoir or the Full Supply Level on the Alameda Reservoir and the Flood Control Level may be left in place but must be surrounded by a dike with a minimum height of 1.5 m above Flood Control Level and the dike shall be riprapped to prevent water erosion. All lines running to or from the facility must be treated in accordance with the provisions of Section B.

D. Oil and Gas Pipelines

i) Pipelines transporting clean oil may be left in place in areas below the Flood Control Level, however, they shall be upgraded to minimize the risk of leakage caused by corrosion or line breakage. Upgrading will consist of replacing the line below the Flood Control Level with externally wrapped and internally coated heavy wall pipe and installing block valves above the points where the line enters and exits the area enclosed by the Flood Control Level.

ii) Pipelines transporting natural gas may be left in place in areas below the Flood Control Level. If there is a risk of the pipeline lifting due to buoyancy forces, the line shall be equipped with pipeline weights sufficient to prevent upward movement.

E. Lease Access Roads

i) For wells and facilities located at elevations above the Flood Control Level, access roads must be constructed to maintain access when water levels are at the Flood Control Level.

ii) For wells located at elevations between the Initial Operating Level on the Rafferty Reservoir or the Full Supply Level on the Alameda Reservoir and the Flood Control Level, access roads must be constructed to maintain access to the wells at water levels up to the elevation of the individual wells.

.2 OILWELL FLOOD PROOFING PROCEDURES

Notwithstanding the provisions noted above, flood proofing could be necessary, dependent on the expected degree of flooding. Consultation with Saskatchewan Energy & Mines has confirmed the industrial and environmental suitability and effectiveness of the following flood proofing measures:

i) Ensure that the lease (area immediately surrounding the well) and equipment is clean and free from oil;
ii) Shut off power. Service boxes will be raised above the Flood Control Level or buried lines will be used in the reservoir flood area;
iii) Remove prime mover (engine or motor);
iv) Disconnect pump jack bridle from polished rod;
v) Disconnect flow line and bull plug each end;
vi) Close and secure all well head valves;
vii) Close surface casing annulus vent;
viii)Close ratigan (well head blow out preventer);

ix) Drain pump jack gear box;

x) Remove all free standing equipment from the lease;

xi) Depending on the severity of the expected flood and the time that the area would be under water, consideration will be given to flushing the flowline.

OIL APPENDICES

A chart of the Rafferty Reservoir filling frequency was prepared by Saskatchewan Water Corporation which shows the probability of the reservoir filling to a given elevation in a period of time. This chart is included in the appendices (Figure 1) and is also included in the Hydrology Section of this Environmental Impact Statement.

Sketches of a typical oil well pumping unit (Figure 2), a typical pumping well head (Figure 3) and a typical oilwell installation (Figure 4) are included in the appendices.

In addition to the above, there is a map of the Rafferty Reservoir showing the oilfield facilities (Figure 5), a similar map of the Alameda Reservoir (Figure 6), a chart showing the profiles of both the Souris Valley (Figure 7) and the Roughbark Creek with the affected wells and facilities shown (Figure 8) and a Mitigation Summary Table (Figures 9a to 9d). Verification Survey Plats for each of 55 oilfield facilities potentially affected by the Rafferty Reservoir are included as Figure 10.

It should be emphasized that, although costs of oilfield mitigation in the Alameda Reservoir have been included, more detailed information will be developed as the timing of the project start is more closely determined, using the same approaches that have been used in the Rafferty Reservoir Studies. This information will be provided to Saskatchewan Environment as part of the Alameda Baseline Information when it becomes available.

CONCLUSION

Pleistocene glaciers covered the area and were responsible for producing small scale topographic features which modified the pre-existing bedrock topography. The most common glacial deposits in the Study Area are morainal in origin. These deposits consist of sandy clay till which forms veneer, plains, rolling moraine or ridged moraine landforms. Till in these landforms is most commonly less than 1 m to greater than 5 m in thickness. Thicker sequences of till are found in deeply incised pre-glacial valleys in the bedrock as well as in rolling to hummocky upland morainal deposits.

Glaciofluvial processes also created erosional and depositional landforms including veneers, blankets, terraces and eskers. A large glaciofluvial blanket deposit is present in the vicinity of Moose Mountain Creek. Local erosion of the tills has produced a boulder pavement and deposits of sand and gravel along the channel of the present day Souris River and Moose Mountain Creek valleys. Recent colluvial deposits also occur in these valleys.

Bedrock immediately beneath glacial deposits consists of the Cretaceous and Tertiary Riding Mountain and Ravenscrag Formations. The Riding Mountain Formation subcrops from Township 4 northward along the Souris River valley; whilst the Ravenscrag Formation underlies all other areas. The Ravenscrag Formation consists of poorly indurated sandstone, siltstone, claystone and lignite. The Riding Mountain Formation is composed of claystone.

The Souris Basin Development Authority currently anticipates that the majority of the economically recoverable gravel within the Rafferty Reservoir area will be required for the construction of the Dam. Any surplus gravel in the Reservoir area not required for the Dam will be extracted and stockpiled. There are no recoverable lignite coal deposits in either of the reservoir areas. While coal exists in the shallow Boundary zone beneath a portion of the Boundary-Rafferty Diversion Channel it is deemed uneconomic to recover. Coal from the overlying Estevan and Souris zones in the southern portion of the Channel location has already been mined. The Authority is committed to an integrated oil well mitigation program which attempts, on the one hand, to minimize the impact the reservoirs will have upon existing facilities and, on the other, to ensure that the environment is adequately protected.

APPENDIX ONE - GRAVEL

GRANULAR RESOURCE STUDY
PROPOSED RAFFERTY RESERVOIR
NEAR ESTEVAN, SASKATCHEWAN

Prepared For:
Souris Basin Development Authority
814 - 4th Street
Estevan, Saskatchewan
S4A 0V9

Prepared By:
Hardy BBT Limited
608 McLeod Street
Regina, Saskatchewan
S4N 4Y1

PROJECT NO. JX60048 **APRIL 30, 1987**

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JX60048-2	Rafferty Reservoir FSL Outline (Scale 1:100,000)
JX60048-3	Saskatchewan Highways and Transportation Granular Pits Specific Study Area and General Study Areas (Scale 1:250,000)
JX60048-4 to 6	Map of Granular Sources Description of Source (Maps Scale 1:50,000) Tables I, II and III
APPENDIX A:	**Test Hole and Test Pit Logs by Drawing JX60048-4 to 6**
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APPENDIX C:	**Aggregate Usage and Aggregate Processing Costs**
APPENDIX D:	**Saskatchewan Highways and Transportation Pit Data on 62E-141**
APPENDIX E:	**Terms of Reference for Study**

1.0 INTRODUCTION AND TERMS OF REFERENCE

This report presents the results of an investigation conducted to evaluate the granular resources within the proposed flooded area of the Rafferty Reservoir on the Souris River. The proposed Rafferty Dam and Reservoir would create a long narrow reservoir which would flood about 68 km of the Souris River Valley.

The terms of reference for this study were to identify potential granular deposits within the Reservoir to assess the economic feasibility of salvaging the deposits prior to flooding. A copy of the request for proposal is included in Appendix E of this report.

Authority to proceed with the study was received orally on March 2, 1987 and confirmed by receipt of Requisition No. 0019 from the Souris Basin Development Authority.

2.0 EXTENT OF INVESTIGATION

2.1 Site Reconnaissance and Review of Available Information

A site reconnaissance was performed on April 9 and April 10 by Mr. Dennis Fex, CET and on March 25, 26, April 6, 7, 9 and 10, 1987 by Mr. Ken Toovey, P. Eng. The purpose of the site reconnaissance was to gain a ground level appreciation for the study area and to visually examine the previously identified potential sites which had the highest probability of containing granular material. During the course of this study, discussions were held with the following sources of information to identify either existing or potential aggregate sources:

1. Representatives of local contracting firms, rural municipalities, towns, villages and cities within close proximity of the proposed Rafferty Reservoir.
2. Local land owners.
3. Mr. Glen Peterson.
4. SHT personnel involved in aggregate source research.

A thorough review of available information included but was not limited to the following:

1. Energy, Mines and Resources 1:50,000 base maps of general study area (with 7.6 m contour intervals).
2. Energy, Mines and Resources 1:250,000 Weyburn Sheet 62E (contour interval 30.5 m).
3. Aerial photographs (Scale 1:10,000) of the Souris River Valley.
4. Mosaic aerial photographs of Souris River Valley general study area.
5. Reports prepared by J.D. Mollard and Associates for Mr. Glen Peterson of Glen Peterson Construction Limited. Reports supplied by Mr. Peterson were:
   a) Estevan Sand and Gravel Airphoto Search - 1980
   b) Supplement to Estevan Sand and Gravel Search - 1980
   c) Weyburn Sand and Gravel Airphoto Search - 1980
6. Saskatchewan Highways and Transportation (SHT) pit information: (computer sheets of test hole logs and laboratory test results, as

well as computer sheets of test hole logs, laboratory test results and site plans showing test hole locations).

7. 1:5000, 1 m contour maps.
8. Relevant R. M. maps.

2.2 Field Investigation

A total of nine (9) areas were designated as test locations in the proposed Rafferty Reservoir Study area. The test hole and test pit logs recorded at each test location are presented in Appendix A. Test drilling for this project was performed using a CME Model 75 auger drill rig. Based on the results of the test drilling, a total of 3 test locations were designated for further investigation by test pit excavation. Test drilling and test pit excavation commenced on April 7, 1987 in accordance with the following schedule:

Date	Test Holes or Test Pits (TP) Completed
April 7, 1987	1 - 7
April 8, 1987	8 - 16
April 9, 1987	17 - 34
April 10, 1987	35 - 37
April 14, 1987	38 - 40
April 15, 1987	41 - 47
April 16, 1987	TP1 - TP6
April 21, 1987	TP33 - TP41

April 22, 1987	TP13 - TP30
April 28, 1987	TP7 - TP12
April 29, 1987	TP31 - TP32

Inclimate weather hampered drilling during the course of the investigation as noted for the field reconnaissance portion of the work. Some difficulty also arose with the placing of bans on municipal roads and time was lost on the project in the procurement of permits.

2.3 Laboratory Testing

The field drilling program with the CME Model 75 auger drill did not facilitate the obtaining of proper granular samples suitable for laboratory analysis. Therefore, the samples obtained were from excavated test pits. No laboratory tests were conducted on recovered samples as the deposit quanities did not appear to warrant further testing.

3.0 SITE CONDITIONS

3.1 Limits of Study Area

The study area specifically covered the maximum flood level of the proposed Rafferty Reservoir to an elevation of 555.0 m. The approximate north boundary of the general study area which included areas of alternate gravel sources and was expressed as an area bound between lines running east-west of Halbrite and the Canada US border. This area is bounded on the west by a line extending north-south through Bromhead and on the east by a line extending north-south through Estevan.

A key plan showing the specific study area and general study area is presented as Drawing JX60048-1. The proposed Rafferty Reservoir outlined at elevation 555.0 m is presented on Drawing JX60048-2 at a scale of 1:100,000.

3.2 Surficial Geology

The present Souris River Valley was deeply incised into the Weyburn Plain. The surface of the till plain is characterized by numerous boulders and some finer gravel which was deposited by the glacier as residual material in the form of lag concentrate or boulder lag. The underfit Souris River occupies the Souris River Valley and meanders over a broad alluvial flood plain consisting predominately of silts and clays. The eroded till plain (known as the 1850 foot terrace) is approximately 30.5 m above the present flood plain of the Souris River. The terrace was formed as a result of the low gradient of the Souris River (.18 m per 1 km).

4.0 EVALUATION

The information obtained from this study is presented on 6 drawings as follows:

JX60048-1 -	Key Plan
JX60048-2 -	Rafferty Reservoir outline at 555.0 m.
JX60048-3 -	at a scale of 1:250,000 (Weyburn base map 62E) showing

all granular pits in the general study area based on information provided by SHT.

JX60048-4 to 6 - at a scale of 1:50,000 base maps showing granular pits of SHT in specific study area of FSL with designated test locations to be drilled or test pits excavated as well as areas to be checked in the field on a preliminary basis.

NOTE: Tables I to III follow Drawings JX60048-4 to 6, respectively, and contain a description of the granular source or potential source.

The test locations and areas initially evaluated were based primarily on consideration of SHT's field test drilling results and the air photo interpretation conducted by J.D. Mollard and Associates. The final exploratory work was based on interviews, discussions and the field reconnaissance. Some tentative locations for test drilling and areas to be examined were subsequently eliminated because of their poor potential as gravel sources as the investigation proceeded.

The consequence of the accumulation of snow in the specific study area and poor drying conditions hampered access to some drilling sites and made field observations of some areas impossible during the initial stages of the investigation. However, access became possible after April 10, 1987.

The evaluation for granular resources within the proposed Rafferty Reservoir for purposes of this investigation was primarily directed toward deposits of gravel and/or cobbles and boulders that were considered to be of value. Deposits of sand were not considered to be of particular importance due to the extensive abundance of sand deposits in the general area. The occurance of coarse gravel deposits and deposits with a large percentage of cobbles and boulders, suitable for crushing high quality aggregate, did not appear to be abundant in the specific study area. However, known deposits in the general study area outside the Reservoir area are shown on Drawing JX60048-3. Outwash plains and outwash stream deposits provided the most important sources of good quality granular material. However, the Souris River Valley is not part of an outwash plain nor do significant outwash stream deposits appear to exist. Granular deposits in the valley bottom tended to be scattered and of limited lateral extent and depth. No granular material could be identified in the numerous exposed old test pits observed during the field reconnaissance. This was confirmed throughout the entire area within the proposed Reservoir.

The area below Weyburn is known to have been searched for granular sources with little or no success. Consequently, Weyburn area users of aggregate rely on sources outside the Souris River Valley. Users of aggregate within the general study area make little use of the limited sources in the Souris River Valley with usage as follows:

Rural Municipalities (1986)	- 38,250 m^3
Dept of Highways & Transportation (1982-86)*	- 20,934 m^3
Cities (1986)	- Nil

Villages & Towns (1986)	-	200 m^3
Misc. (1986)	-	Nil

Total usage from Souris River Valley sources = 42,637 m^3

These values were obtained from the individual agencies and reflect, within a reasonable level of accuracy, the average granular material consumption over the past few years.

* Total for years shown (average usage 4,187 m^3 per year)

For purposes of this investigation, it was assumed that a viable gravel source required following characteristics:

1. The deposit contained material retained on the 4.75 mm (#4) sieve but, smaller than 0.6 m in diameter, equal to 25% to 40% of the total deposit.
2. The deposit was overlain with no more than 0.15 m to 0.30 m of overburden for each 0.30 m of granular material.
3. A minimum volume of gravel in the order of 11,500 m^3 to 19,000 m^3 was available from the source.
4. Material passing the 80 um (#200) sieve did not exceed 8.0%.
5. The material was above present groundwater levels unless the quality and quantities justified dewatering costs for recovery.
6. A reasonable haul distance could be anticipated and accessability to the source was feasible.
7. The granular deposit was relatively free of deleterious materials.

The test locations investigated for this study indicated that only 3 of the 9 test locations had gravel. The three locations were:

Test Location 2

Test Location 7

Test Location 9

The lateral extent of the gravel deposits and depth of the deposits was determined in the field by means of drilling test holes, excavating test pits and visual examination. Only Test Location 7 revealed a source of limited local significance and the source contained large shale inclusions. Therefore, this deposit appears to be of little commercial value and falls outside the established criteria.

The majority of granular deposits and, in particular, those deposits consisting of gravel or rock suitable for crushing are scarce and the majority of sources have been worked extensively or exist as active pits. In the active pits, the bulk of the gravel that formed part of the deposits have been mined out to depletion or near depletion except for SHT pit 62#-141. A site plan of this pit, logs and laboratory analysis conducted by SHT is presented in Appendix D. An investigation of the area adjacent to this pit indicated that the limits of the pit have been well defined.

Some of the potential sites are below the existing water table and, at this point, are not considered to be economical. Other deposits may be situated in areas where overburden is excessive. Based on the results of the investigation, and available it appears that SHT Pit 62E-141 is the only economically recoverable gravel source in the specific study area.

CLOSURE

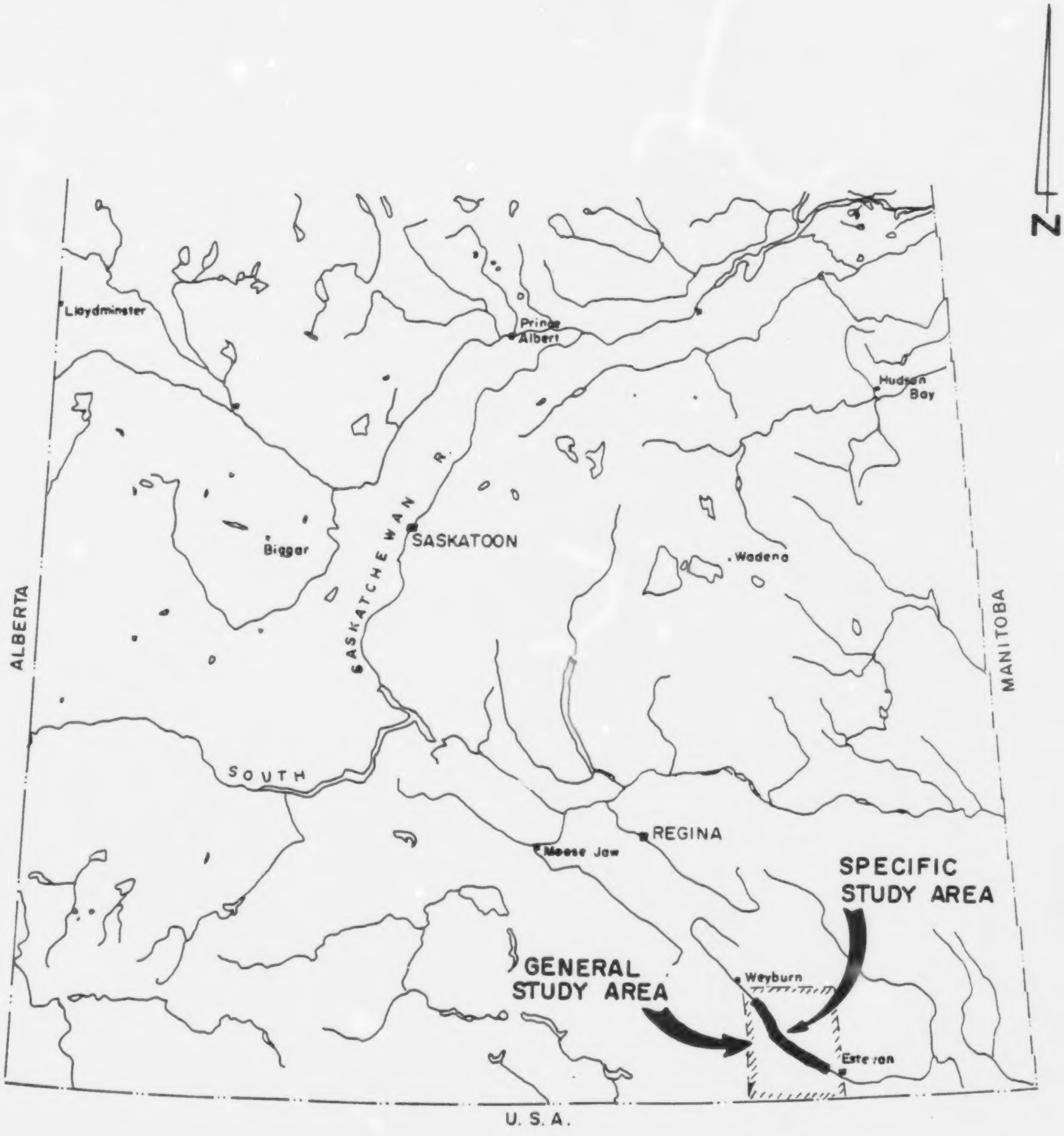
The findings and conclusions of this report were prepared in accordance with generally accepted professional engineering principles and practice. The findings and recommendations were based on available information, opinions of others knowledgeable in aggregate sources in the study area, field reconnaissance and field exploration.

Respectfully submitted,
Hardy BBT Limited

K.S. Toovey, P. Eng.

Reviewed and Approved By:
A.J. Muir, P. Eng.

KST:AJM:mt

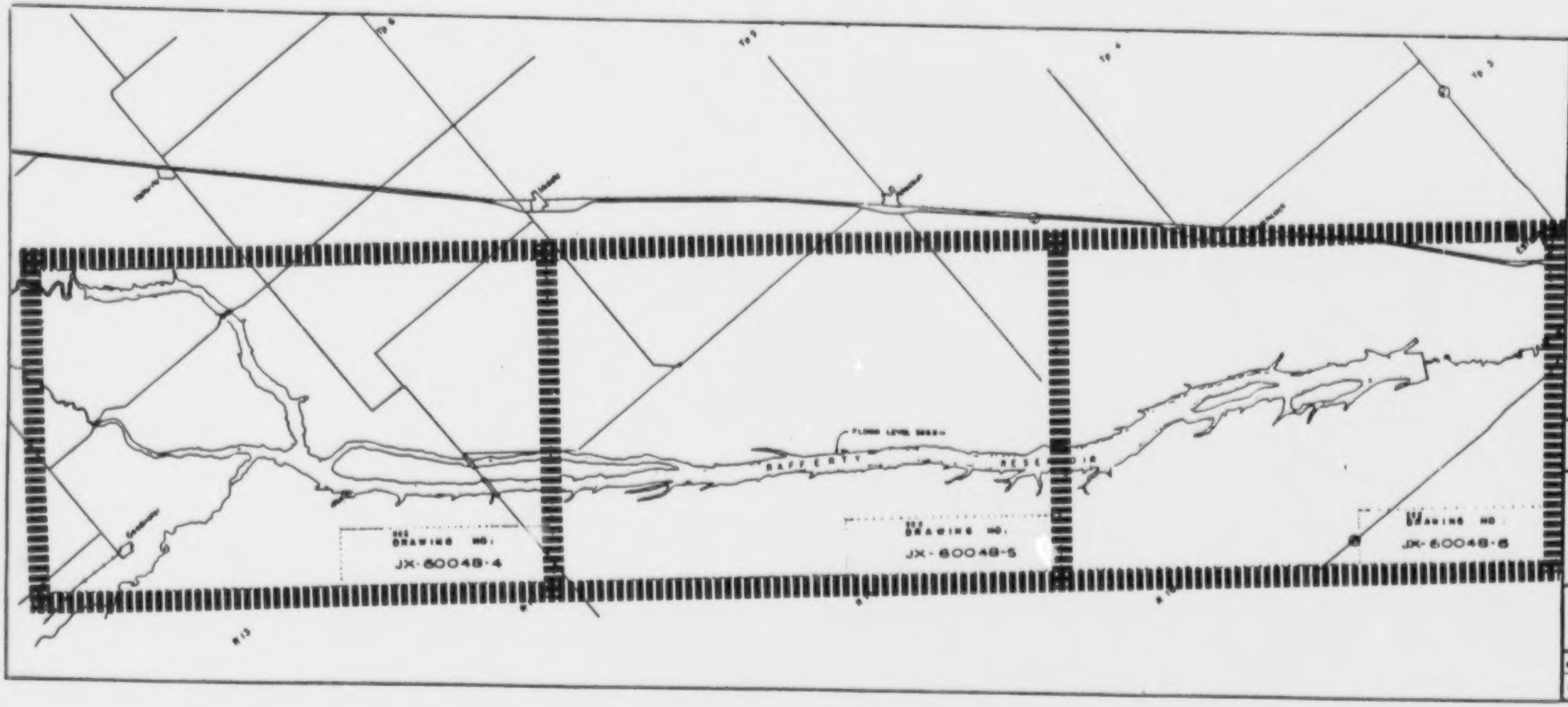

N
Lloydminster
Prince Albert
Hudson Bay
SASKATCHEWAN R.
SASKATOON
Biggar
Wadena
ALBERTA
MANITOBA
SOUTH
REGINA
Moose Jaw
SPECIFIC STUDY AREA
GENERAL STUDY AREA
Weyburn
Estevan
U.S.A.

Hardy BBT Limited
CONSULTING ENGINEERING & PROFESSIONAL SERVICES

GRANULAR RESOURCE STUDY
RAFFERTY RESERVOIR, SASKATCHEWAN

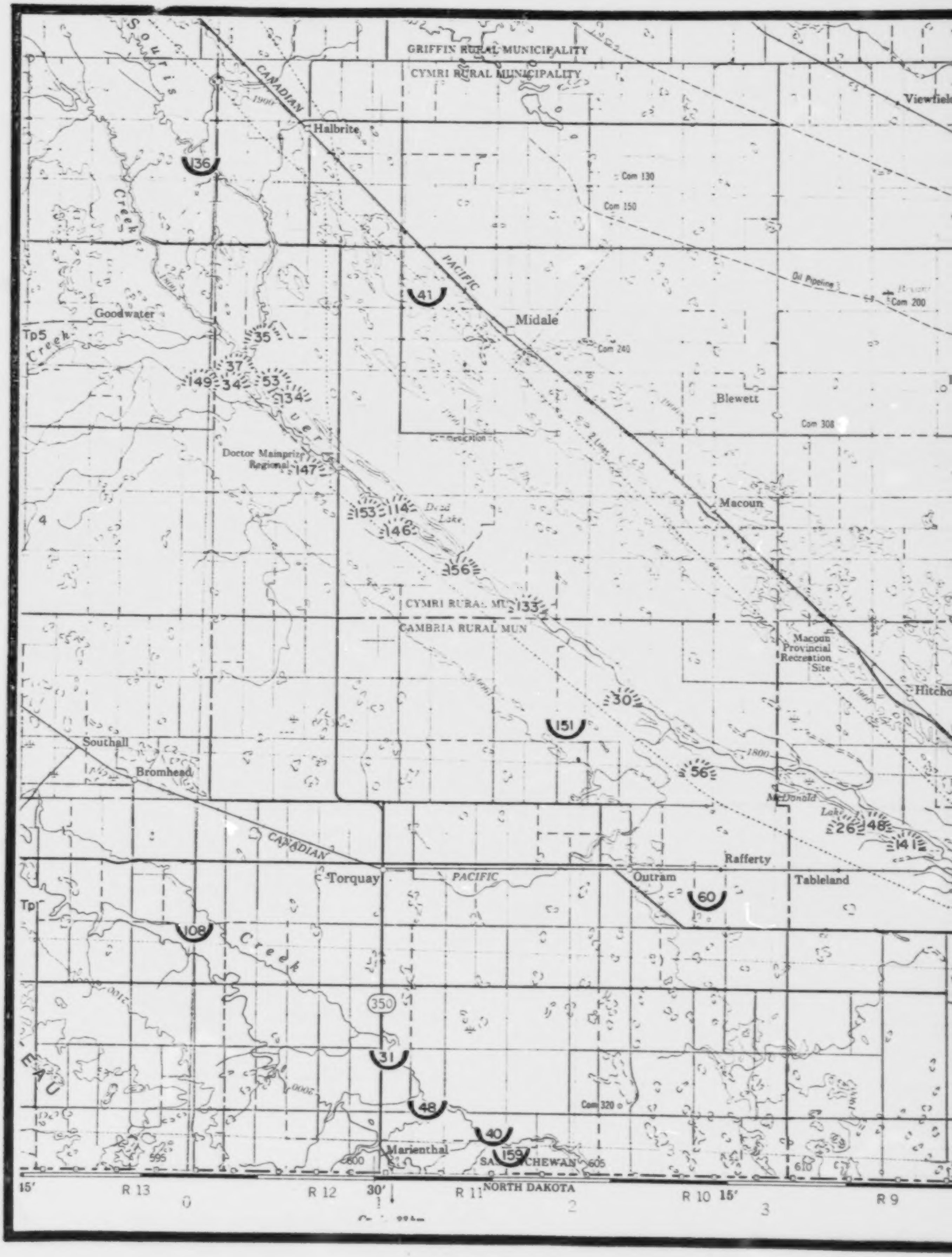
KEY PLAN

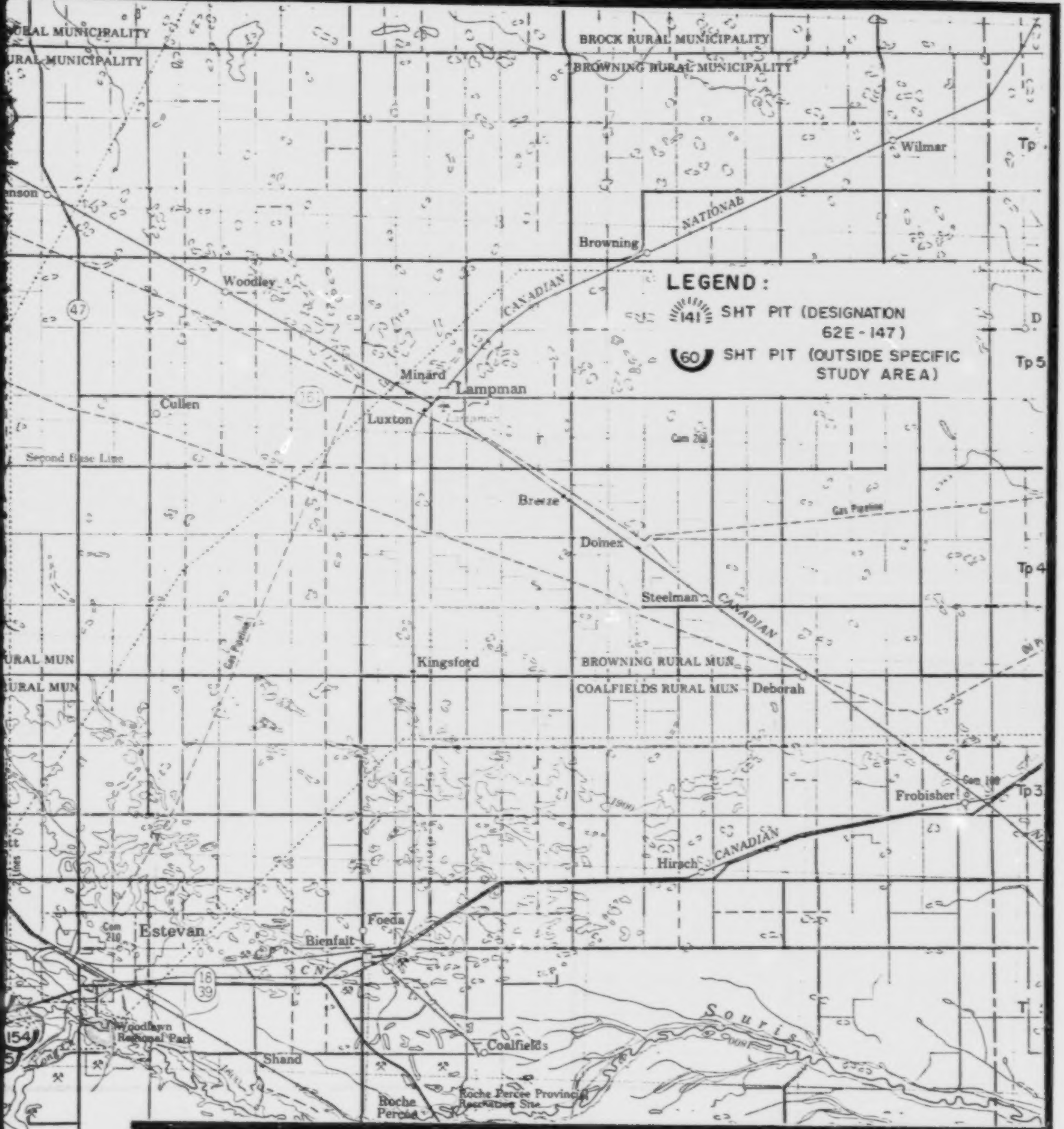
Scale	Date	Drawn By	DRAWING NO:
N.T.S	APRIL '87	W.T.	JX-60048-1


Tp 6
Tp 5
Tp 4
Tp 3
N
FLOOD LEVEL 560.0 m
RAFFERTY RESERVOIR
SEE DRAWING NO. JX-60048-4
SEE DRAWING NO. JX-60048-5
SEE DRAWING NO. JX-60048-6
R 13

GRANULAR
RESOURCE STUDY
RAFFERTY RESERVOIR
SASKATCHEWAN

JX-60048-2


GRIFFIN RURAL MUNICIPALITY
CYMRI RURAL MUNICIPALITY
Viewfield
Souris
CANADIAN
PACIFIC
Halbrite
136
Creek
Com 130
Com 150
Oil Pipeline
Com 200
41
Midale
Goodwater
Tp5
Creek
35
Com 240
37
149
34
53
134
River
Blewett
Com 308
Doctor Mainprize Regional
147
Macoun
153
114
Dead Lake
146
4
56
CYMRI RURAL MU
133
CAMBRIA RURAL MUN
Macoun Provincial Recreation Site
Hitcho
30
151
Southall
Bromhead
56
1800
McDonald Lake
26
48
141
CANADIAN
Torquay
PACIFIC
Outram
Rafferty
Tableland
60
Tp
108
Creek
350
31
2000
48
Com 320
40
Marienthal
159
SASKATCHEWAN
NORTH DAKOTA
595
600
605
610
15′
R 13
0
R 12
30′
1
R 11
2
R 10
15′
3
R 9


RURAL MUNICIPALITY
RURAL MUNICIPALITY
BROCK RURAL MUNICIPALITY
BROWNING RURAL MUNICIPALITY
Wilmar
Tp
NATIONAL
Browning
CANADIAN
Woodley
47
LEGEND:
141 SHT PIT (DESIGNATION 62E-147)
60 SHT PIT (OUTSIDE SPECIFIC STUDY AREA)
D
Tp 5
Minard
Lampman
Cullen
18
Luxton
Lampman
Com 260
Second Base Line
Breeze
Gas Pipeline
Dolmex
Tp 4
Steelman
CANADIAN
Gas Pipeline
RURAL MUN
RURAL MUN
Kingsford
BROWNING RURAL MUN
COALFIELDS RURAL MUN
Deborah
Com 190
Frobisher
Tp 3
1900
CANADIAN
Hirsch
Foeda
Com 210
Estevan
Bienfait
CN
18
39
Woodlawn Regional Park
154
Shand
Souris
Coalfields
Roche Percee
Roche Percee Provincial Recreation Site
T
Estevan
Dam
39
130
129
47
R 8 103°00′

Hardy BBT Limited

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Scale : 1 : 250 000

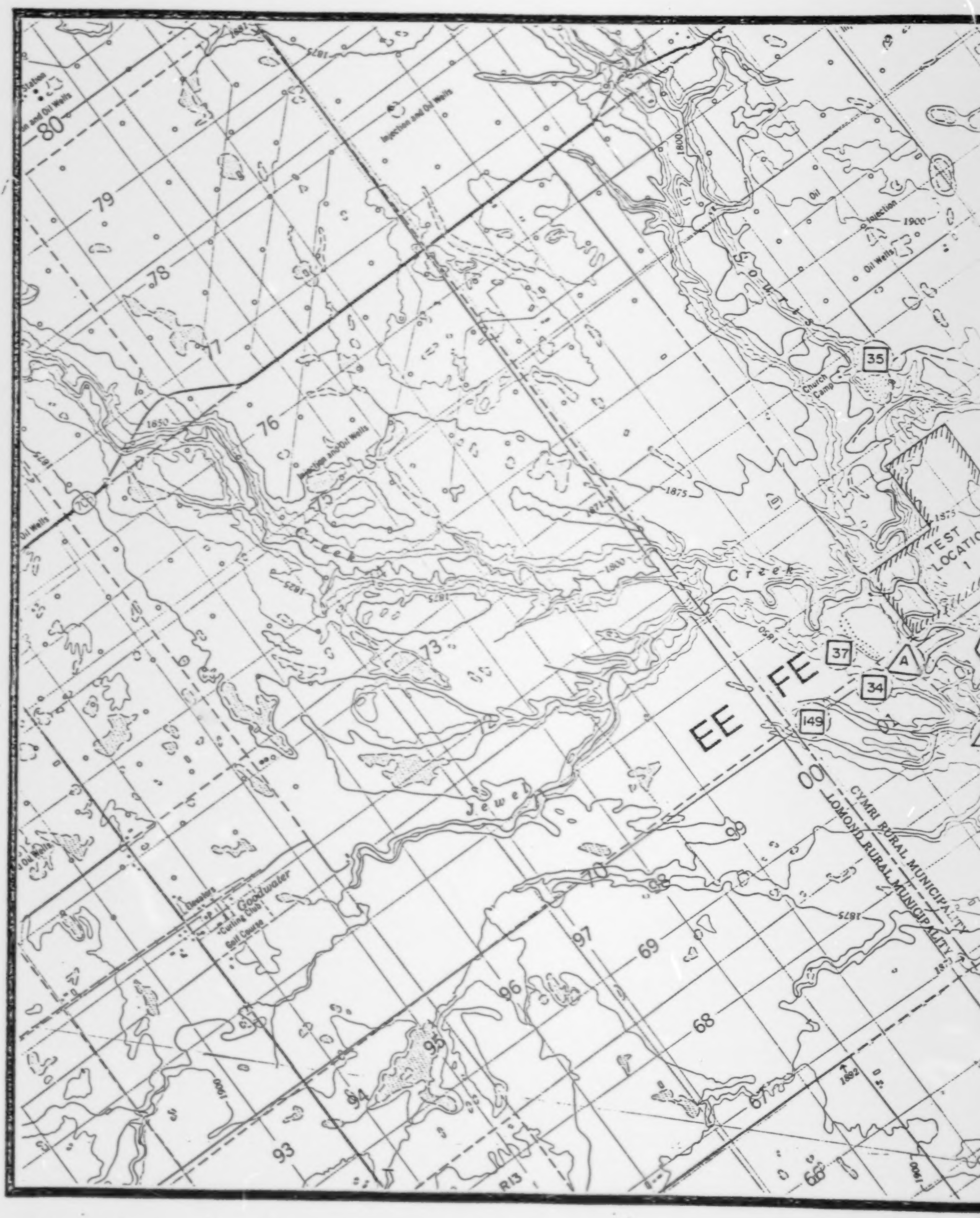
Date : APRIL '87

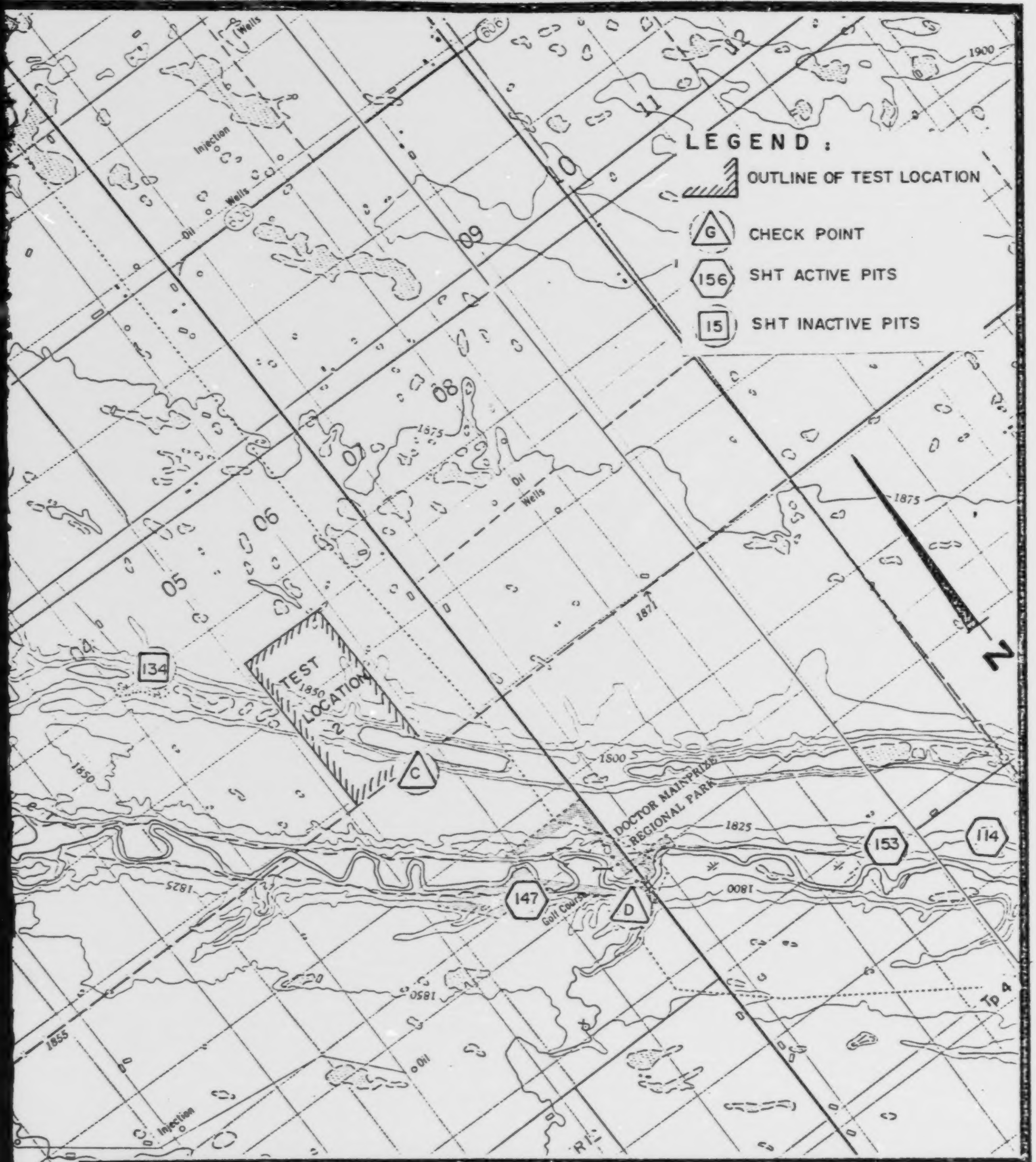
Drawn By :

Approved By :

Drawing No: JX-60048-3

GRANULAR RESOURCE STUDY
RAFFERTY RESERVOIR, SASKATCHEWAN


Station
Injection and Oil Wells
80
79
78
77
76
75
73
Injection and Oil Wells
Injection and Oil Wells
Oil Wells
Oil Wells
S o u r i s
Oil
Injection
Oil Wells
1900
1800
1875
1850
1825
35
Church Camp
TEST LOCATION 1
C r e e k
C r e e k
37
A
34
149
EE
FE
00
CYMRI RURAL MUNICIPALITY
LOMOND RURAL MUNICIPALITY
J e w e l
Goodwater
Elevators
Curling Club
Golf Course
70
69
68
67
66
97
96
95
94
93
1892
R13


LEGEND :
OUTLINE OF TEST LOCATION
G CHECK POINT
156 SHT ACTIVE PITS
15 SHT INACTIVE PITS
TEST LOCATION 2
C
D
134
147
153
114
DOCTOR MAINPRIZE REGIONAL PARK
Golf Course
Oil Wells
Injection
Wells
Oil
1900
1875
1871
1850
1825
1800
1855
12
11
10
09
08
07
06
05
04
N
Tp 4
R1

Hardy BBT Limited
CONSULTING ENGINEERING & PROFESSIONAL SERVICES

GRANULAR RESOURCE STUDY
RAFFERTY RESERVOIR, SASKATCHEWAN

Scale : 1: 50 000
Date : APRIL '87
Drawn By : W.T.
Approved By :
Drawing No : JX-60048-4

TABLE I

Study Area Covered By Drawing

JX60048-4

* NOTE - SHT pits designated with 62E prefix

	Granular Soures Area Investigated or Drilled	Location	Comment (Status and Other Pertinent Information
1.	62E - 35	E 1/2 20-5-12-2	SHT owned. Gravel depleted. Sand in centre of deposit 34,000 m^3. Pit is active.
2.	Test Location 1	NE, SE and SW 1/4 17-5-12-2	A total of 7 test holes drilled with no significant sand or gravel recorded. See Test Location Sheets for test hole logs.
3.	62E - 37	SE 18-5-12-2	SHT owned. Pit has been worked extensively. Gravel that remains is a small amount and consists of material minus 80mm below water table. Outwash deposit with 15,400 m^3. Sand of which 9,100 m^3 is above water table. No stockpiles. Pit is active.
4.	Area A	SE 18-5-12-2	Small sand deposit north and west of bridge. Most of deposit depleted. Sand only.
5.	62E - 34	NE 7-5-12-2	SHT owned. 19,000 m^3 sand within some fine gravel. Small stockpile road gravel. Pit is active.
6.	62E - 149	NW 7-5-12-2	Crown Land RM #36. Quarrying lease site. No department test data available. Sand only. Small stockpile of sand and base of pit 1.5-1.8 m above water table. Pit is active.

7.	62E - 53	N 1/2 8-5-12-2	SHT owned. RM #36 lease site. Deplete except for sand and fine gravel below water table. Some dewatering being attempted by others to recover material.
8.	Area B	SW 1/4 8-5-12-2	Deplete pit. Scattered gravel and sand.
9.	62E - 134	SW 1/4 9-5-12-2	Crown Land RM #36. Quarrying lease. No department test data available. Base of pit near water table. Stockpiled road gravel estimated 50,000 m^3 within area. Pit active.

Note: Proposed closure dams will preclude inundation by Reservoir.

10.	Test Location 2	W 1/2 3-5-12-2	A total of 3 test holes drilled. Sand and some gravel found. Area not considered for investigation by backhoe. See Test Location Sheet for test hole logs.

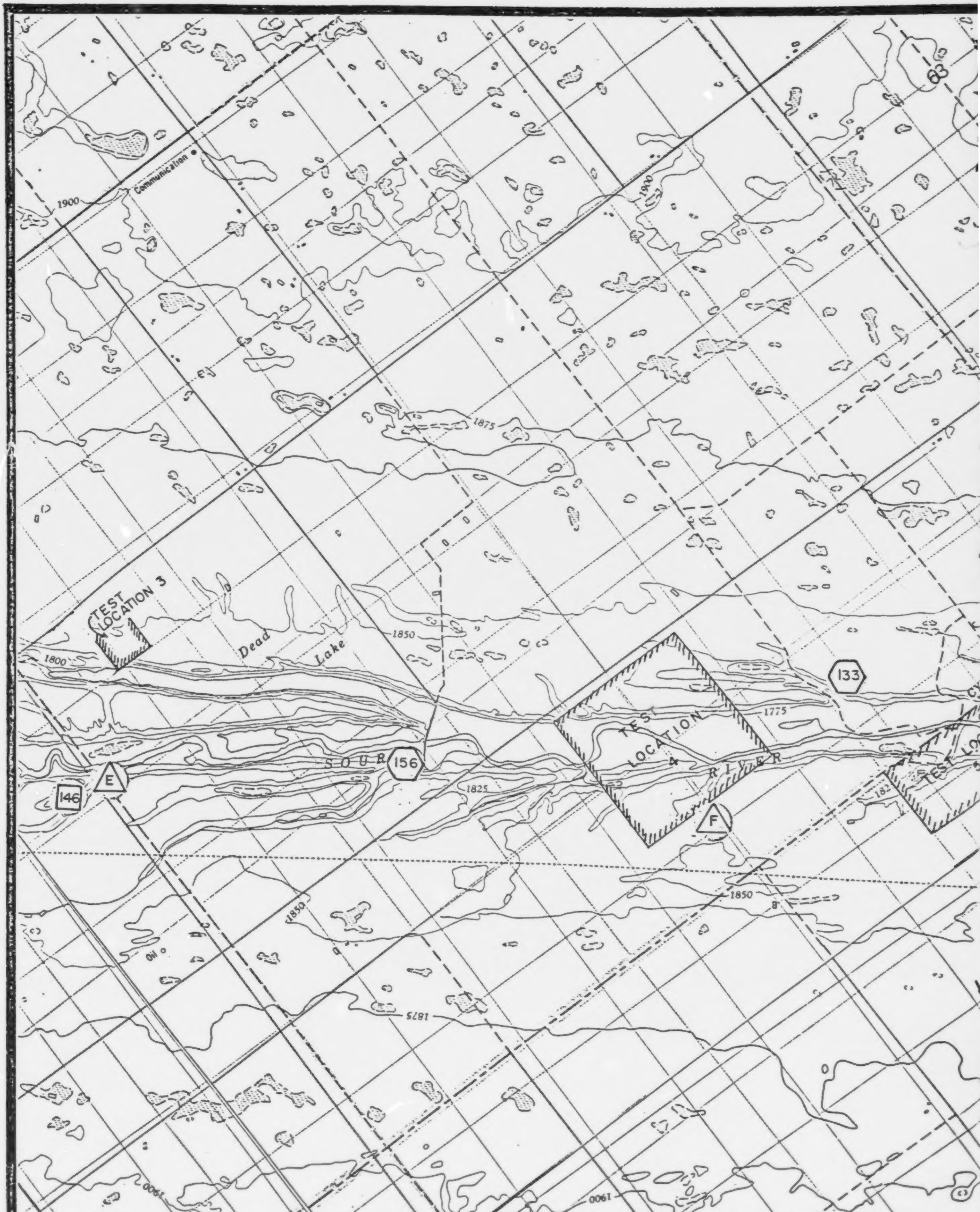
Note: as per 9. above.

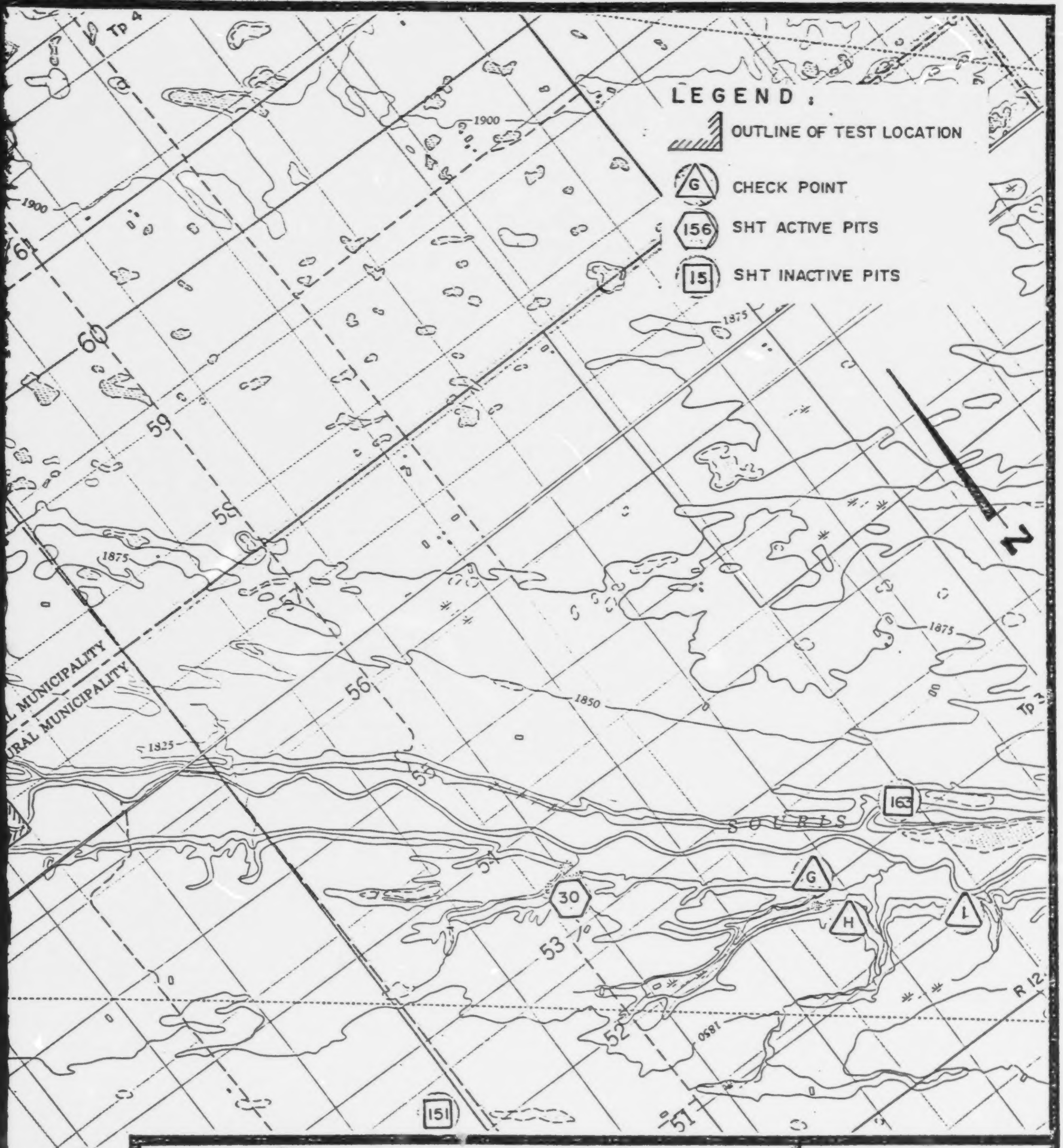
11.	Area C	NW 1/4 34-5-12-2	Terrace remnants boulders at surface. Prospect not considered for drilling or for investigation with backhoe.

Note: as per 9. above.

12.	62E - 147	NW 27 and SW 24 4-12-2	Crown Land R M # 36. Quarry lease site. Depleted of useable material and confirmed by visual inspection.

13.	Area D	NE 27-4-12-2	Some surface boulder cuts indicate glacial till. Not considered for further investigation.
14.	62E - 153	NW 24 and SW 25 4-12-2	Crown Land. Quarring lease RM #36. No test information. Confirmed deplete of useable material.
15.	62E - 114	NE 24-4-12-2	As per 62E - 153.


Communication
1900
63
1875
TEST LOCATION 3
Dead Lake
1800
1850
133
1775
TEST LOCATION 4
SOUR RIVER
156
146
E
F
1825
TEST LO
1850
Oil
1875
1900


LEGEND :
OUTLINE OF TEST LOCATION
G CHECK POINT
156 SHT ACTIVE PITS
15 SHT INACTIVE PITS
Tp 4
Tp 3
R 12
N
1900
1875
1850
1825
61
60
59
58
57
56
55
54
53
52
51
MUNICIPALITY
MUNICIPALITY
SOURIS
163
30
151
G
H
I

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Scale :	1: 50 000
Date :	APRIL '87
Drawn By :	W. T.
Approved By :	
Drawing No:	JX-60048-5

GRANULAR RESOURCE STUDY
RAFFERTY RESERVOIR, SASKATCHEWAN

TABLE II

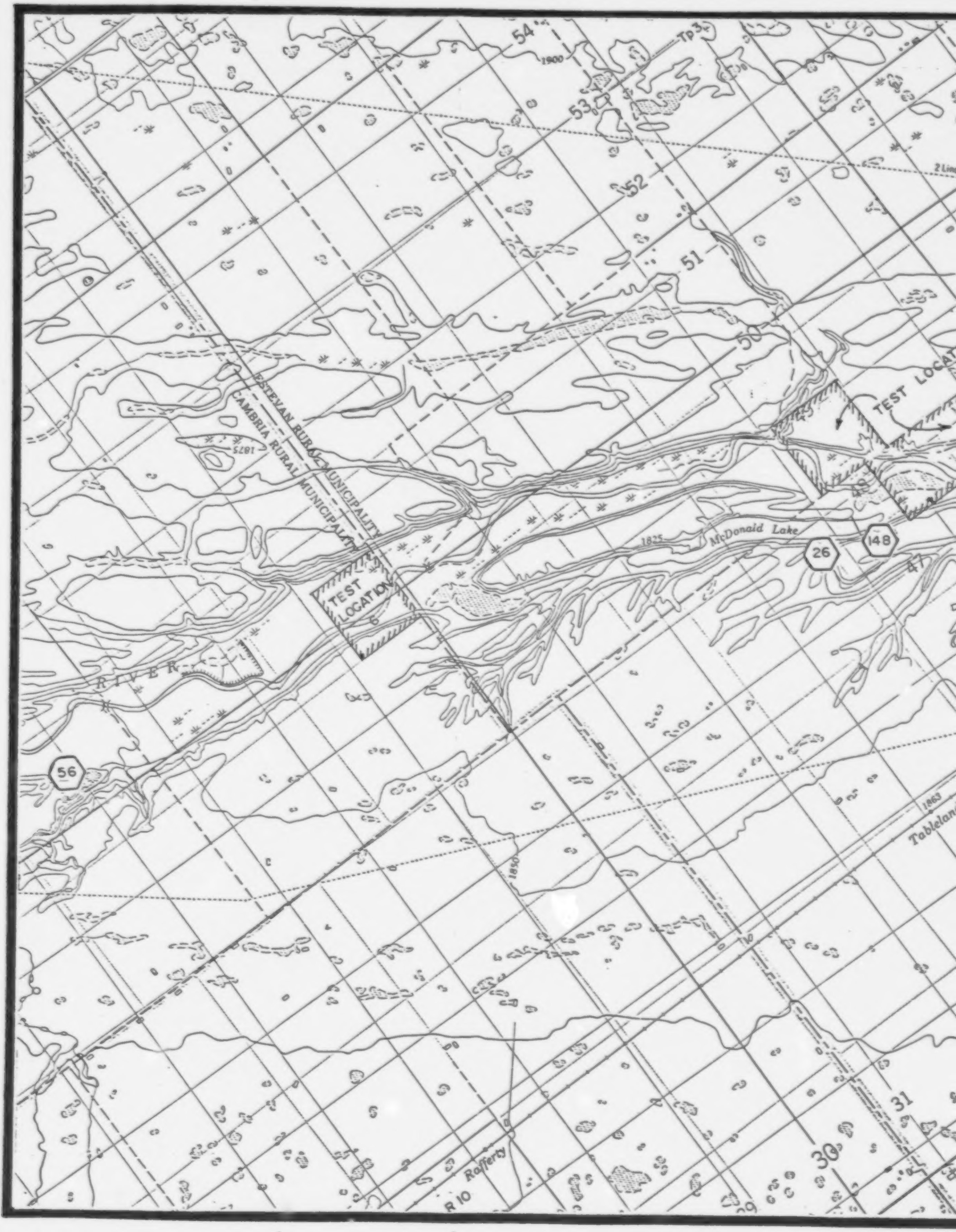
Study Area Covered by Drawing

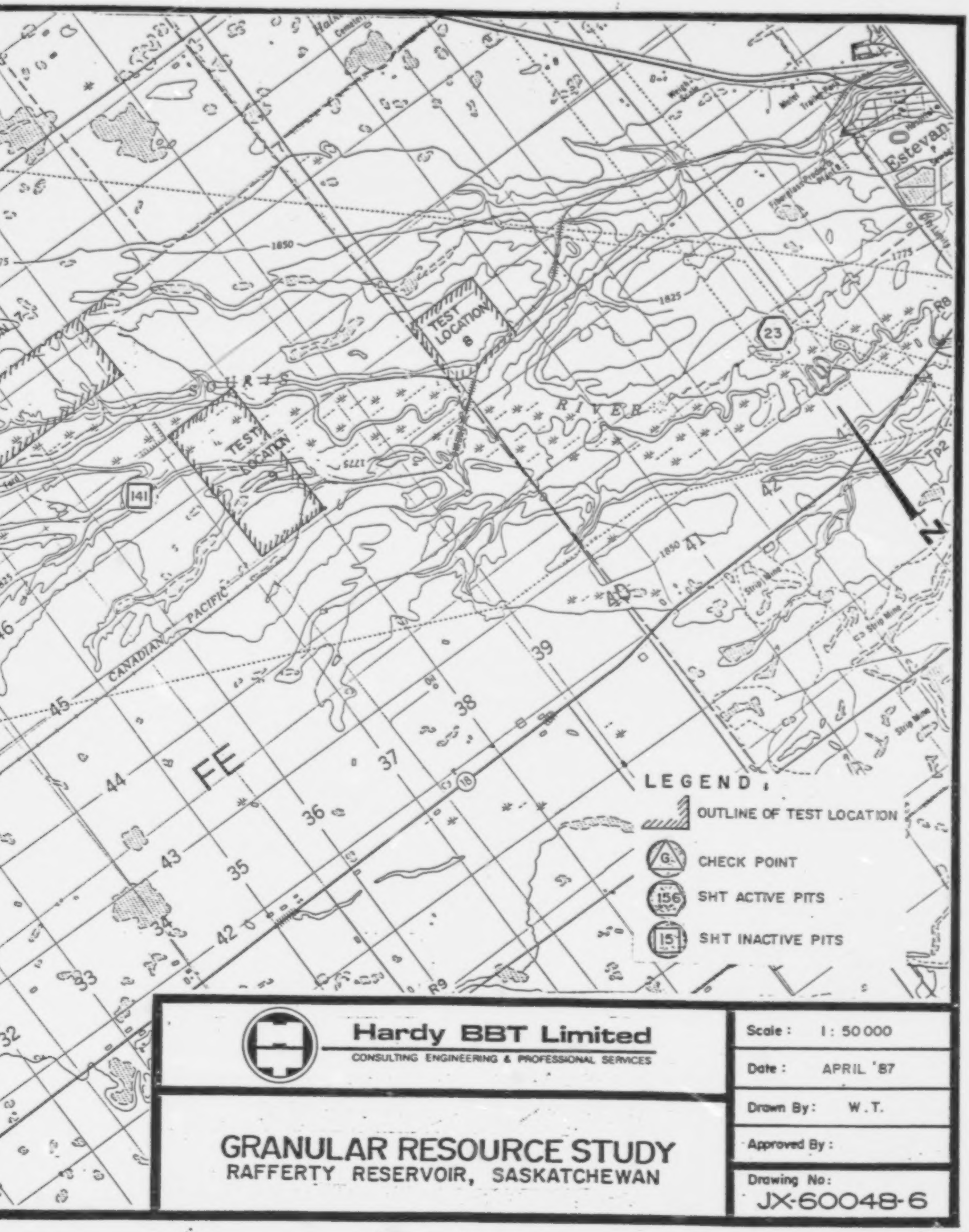
JX60048-5

NOTE - SHT pits designated with 62E prefix

	Granular Soures Area Investigated or Drilled	Location	Comment (Status and Other Pertinent Information
1.	62E - 146	NE 13 and SE 24 4-12-2	Crown Land. Quarrying lease site. RM 336. No test information. Active pit. Unable to get into pit site April 10 or 28. Active pit.
2.	Test Location 3	NE 19-4-11-2	Prospect has boulders at surface. A total of 3 test holes drilled at this location. Some sand but further investigation not warranted.
3.	Area E	NW 18-4-11-2	Air photos indicate poor prospect (collapsed super glacial debris) deposit extension of 62E-146 but unable to gain access to site. Poor prospect.
4.	62E - 156	NE 8-4-11-2	Crown Land former RM #36. Quarrying lease site. Pit is deplete of useable material.
5.	Test Location 4	SE 1/4 9, SW 1/4 10 NW and SE 1/4 3 and NE 1/4 4 4-11-2	Prospect has numerous boulders at surface. Some sand encountered but deposit not considered for further investigation. A total of 18 test holes were drilled at this location.
6.	Area F	SW 1/4 4-11-2	Prospect is immediately adjacent Test Location 4 and not considered for further investigation.

7.	62E - 133	W 1/2 2-4-11-2	Crown Land. Former RM #36. Quarrying lease site. Confirmed depleted of suitable material.
8.	Test Location 5	N 1/2 35-3-11-2	A total of 6 test holes drilled at this site. Glacial till and sand predominate. Not considered for further investigation. See Test Location Sheets for logs.
9.	62E - 30	SW 1/4 20-3-10-2	Private pit. Deplete of material for SHT Returned to owner in 1981.
10.	62E - 151	NW 13-3-11-2	Private pit. Out of study area. Sand only estimated at 111,200 m^3
11.	62E - 163	NW 16-3-10-2	Crown Land. RM #6. Quarrying lease site. No test information. Active pit. Unable to get into pit site.
12.	Areas G, H & I	NW, SW and SE 1/4's 16-3-10-2	Outwash and outwash remnants. Very poor prospects and not considered for further testing.


54
1900
Tp3
53
52
51
50
2 Lin
TEST LOCA
ESTEVAN RURAL MUNICIPALITY
CAMBRIA RURAL MUNICIPALITY
1875
1825
McDonald Lake
26
148
47
TEST LOCATION
6
RIVER
56
1863
Tableland
1850
10
31
30
Rafferty
R 10


Estevan
Cemetery
Weigh Scale
Motel
Trailer Park
Fiberglass Products Plant
1850
1825
1775
TEST LOCATION 8
TEST LOCATION 9
SOURIS
RIVER
23
141
18
R8
Tp2
R9
N
42
41
40
39
38
37
36
35
34
33
32
43
44
45
46
FE
CANADIAN PACIFIC
Strip Mine
LEGEND
OUTLINE OF TEST LOCATION
G.
CHECK POINT
156
SHT ACTIVE PITS
15
SHT INACTIVE PITS

Hardy BBT Limited
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GRANULAR RESOURCE STUDY
RAFFERTY RESERVOIR, SASKATCHEWAN

Scale : 1 : 50 000
Date : APRIL '87
Drawn By: W.T.
Approved By :
Drawing No: JX-60048-6

TABLE III

Study Area Covered by Drawing

JX60048-6

*NOTE - SHT pits designated with 62E prefix

	Granular Soures Area Investigated or Drilled	Location	Comment (Status and Other Pertinent Information
1.	62E - 56	SW 10-3-10-2	Crown Land former RM #6. Quarrying lease site. Depleted of suitable material.
2.	Test Location 6	SE 1/4 12-3-10-2	Three test holes drilled at test location. Some sand in one test hole. No further drilling or investigation.
3.	62E - 26	NE 1/4 32-2-9-2	PFRA past use. No testing. Depleted.
4.	62E - 148	NW 1/4 33-2-9-2	Private pit. Gravel depleted of material suitable for SHT use. Contained 8,200 m^3 of fine to coarse gravel, 3,100 m^3 above water table. Allivial fan deposit.
5.	Test Location 7	NE 33, NE, NW 34, NW 35 2-9-2 SE 4-3-9-2	A total of 6 test holes drilled at this location at top of slope. Test pits near bottom of slope die not indicate presence of gravel.
6.	Test Location 8	SE 1/4 25-2-9-2 (north side valley bottom)	One test hole drilled at this site. Glacial till with no gravel or sand.
7.	Test Location 9	W 1/2 26-2-9-2	One test pit excavated. Gravel encountered but test pits excavated indicated little or no gravel present.

8.	62E - 141	N 1/2 27-2-9-2	Private. SHT volume agreement with owner. Gravel 113,000 m^3 proven. Terrace deposit. SHT logs indicate little or no gravel to east and very little gravel to west of open pit.

APPENDIX A

Gravel Resource Study Area

Covered By Drawings JX60048-4 to 6 inclusive

Logs of Test Holes and Test Pits in:

Test Locations 1 - 2: refer to Drawing JX60048-4

Test Locations 3 - 5: refer to Drawing JX60048-5

Test Locations 6 - 9: refer to Drawing JX60048-6

TEST LOCATIONS 1 - 2

TEST LOCATION 1

Test Hole No.	Location	Depth (m)	Soil Description
1	NE 1/4 17-5-12-2 (1/2 way up valley)	0 - 0.5	Sand Till -
		0.5 - 2.5	Sand (till-like) - some clay, poorly graded, loose light brown
		2.5 - 6.1	Clay till - light brown
2	NE 1/4 17-5-12-2 (valley bottom)	0 - 0.3	Topsoil
		0.3 - 3.7	Silt - sandy, medium brown
		3.7 - 4.6	Clay till - sandy, non-plastic, medium brown
3	NE 1/4 17-5-12-2 (valley bottom)	0 - 0.9	Sand - silty, poorly graded, medium brown
		0.9 - 6.1	Sand - silty, light brown
4	SE 1/4 17-5-12-2 (valley bottom)	0 - 6.1	Clay till - very stiff, dark brown
5	SE 1/4 17-5-12-2	0 - 3.8	Silt - sandy, light brown
		3.8 - 4.6	Clay till - medium to dark brown
6	SW 1/4 17-5-12-2	0 - 4.6	Silt - sandy
7	SW 1/4 17-5-12-2	0 - 1.8	Silt - sandy
		1.8 - 4.3	Sand - gravelly, fine light brown
		4.3 - 6.1	Clay till - dark brown

TEST LOCATION 2

Test Hole No.	Location	Depth (m)	Soil Description
45	W 1/2 3-5-12-2	0 - 1.9	Clay - trace sand, moist organic to 0.3 m
		1.9 - 2.7	Sand - gravelly, silty clayey
46	W 1/2 3-5-12-2	0 - 3.1	Clay - silty, trace sand and gravel
		3.1 - 4.3	Sand - very moist, gravel lense 3.7 - 3.8 m
47	W 1/2 3-5-12-2	0 0.7	Topsoil
		0.7 - 1.5	Gravel - sandy

Test Pit No.	Soil Description
33 to 41	Test pits excavated 2.4 to 3.0 m. Topsoil to 0.4 m followed by clay or silty sand or sand and gravel underlain by clay till. Granular deposits not continuous and considerable variation in thickness. No quantity estimate feasible and area not considered to be an economic source.

TEST LOCATIONS 3 TO 5 INCLUSIVE

TEST LOCATION 3

Test Hole No.	Location	Depth (m)	Soil Description
8	NE 1/4 19-4-11-2 (north side of river)	0 - 0.2	Topsoil
		0.2 - 1.3	Clay till - silty, boulders medium brown
		1.3 - 6.1	Sand - dry, loose, poorly graded, light brown
9	NE 1/4 19-4-11-2 (north side of river)	0 - 0.2	Topsoil
		0.2 - 2.2	Clay till - medium brown
		2.2 - 3.4	Sand - silty, poorly graded, medium brown
		3.4 - 4.6	Clay till - dark brown
10	NE 1/4 19-4-11-2	0 - 0.2	Topsoil
		0.2 - 4.6	Clay till - some cobbles 0.2 - 0.5 m, light brown

TEST LOCATION 4

Test Hole No.	Location	Depth (m)	Soil Description
11	SE 1/4 9-4-11-2 (on plateau north side)	0 - 0.1	Topsoil
		0.1 - 0.3	Sand till - gravelly, medium brown
		0.3 - 4.6	Clay till - medium brown
12	SE 1/4 9-4-11-2 (on top of slope north side)	0 - 4.6	Clay till - medium brown, boulders at surface
13	SE 1/4 9-4-11-2 (on top of slope north side)	0 - 4.6	Clay till - medium brown, boulders at surface
14	SE 1/4 10-4-11-2 (on top of slope north side)	0 - 0.2	Topsoil - boulders at surface
		0.2 - 4.6	Clay till - light brown, dark brown at 3.7 m
15	SE 1/4 10-4-11-2 (valley bottom north side)	0 - 1.9	Clay - very moist, medium grey
		1.9 - 4.0	Clay - medium brown
		4.0 - 4.6	Clay till - very moist, medium brown
16	SW 1/4 10-4-11-2 (on plateau north side)	0 - 0.5	Clay till - boulders at surface, medium brown
		0.5 - 4.6	Clay till - medium to dark brown
17	NW 1/4 3-4-11-2 (valley bottom north side)	0 - 0.5	Clay till - medium brown
		0.5 - 2.2	Silt till - light brown
		2.2 - 4.6	Clay till - medium brown
18	NW 1/4 3-4-11-2 (valley bottom north side)	0 - 0.5	Clay till - boulders at surface, medium brown
		0.5 - 1.3	Sand till - medium brown
		1.3 - 4.6	Clay till - medium grey
19	NW 1/4 3-4-11-2 (valley bottom south side)	0 - 0.5	Topsoil
		0.5 - 4.6	Clay till - medium brown

20	NE 1/4 4-4-11-2 (on plateau south side)	0 - 0.3	Topsoil
		0.3 - 1.5	Silt till - medium brown
		1.5 - 1.9	Sand - poorly graded, medium brown
		1.9 - 4.6	Clay till - dark brown
21	NE 1/4 4-4-11-2 (in plateau south side)	0 - 0.5	Clay till - medium brown
		0.5 - 1.4	Silt till - light brown
		1.4 - 3.1	Sand - silty, fine, poorly graded, medium brown
		3.1 - 4.6	Clay till - dark brown
22	NE 1/4 4-4-11-2 (on plateau south side)	0 - 0.7	Topsoil
		0.7 - 1.5	Sand - gravelly, light brown
		1.5 - 3.1	Sand - poorly graded, medium to fine, medium brown
		3.1 - 4.6	Clay till - dark brown
23	SE 1/4 3-4-11-2 (on top of valley slope, south side)	0 - 0.2	Topsoil
		0.2 - 1.9	Silt till - light brown
		1.9 - 4.6	Clay till - medium to dark brown
24	SE 1/4 3-4-11-2 (on top of valley slope, south side)	0 - 1.5	Clay till - boulders at surface, medium brown
		1.5 - 3.1	Clay till - dark brown to grey, cobbles at 3.1 m
25	SE 1/4 3-4-11-2 (on top of valley slope, south side)	0 - 2.5	Clay till - boulders at surface, light brown
		2.5 - 4.3	Silt till - medium brown
		4.3 - 4.9	Sand - poorly graded, medium brown
		4.9 - 6.1	Clay till - dark brown
26	SW 1/4 2-4-11-2 (valley bottom south side)	0 - 3.4	Clay till - boulders at surface, light brown
		3.4 - 4.6	Silt - sandy, medium brown
27	SW 1/4 2-4-11-2 (on top of valley slope south side)	0 - 4.6	Clay till - medium to dark brown
28	SW 1/4 2-4-11-2 (on top of valley slope south side)	0 - 2.2	Clay till - boulders at surface, medium brown
		2.2 - 4.6	Sand - silty, fine to medium grained, poorly graded, medium brown

TEST LOCATION 5

Test Hole No.	Location	Depth (m)	Soil Description
29	NW 1/4 31-3-11-2	0 - 4.6	Clay till - boulders at surface, light brown, medium to dark brown after 1.9 m
30	NW 1/4 31-3-11-2	0 - 0.9	Clay till - cobbles and boulders at surface, medium brown
		0.9 - 4.6	Sand - silty, damp to moist, poorly graded, fine, medium brown
31	NW 1/4 35-3-11-2	0 - 0.4	Clay till - boulders 0-0.4 m, medium brown
		0.4 - 4.6	Sand - moist, poorly graded, fine, medium brown
32	NE 1/4 35-3-11-2	0 - 4.6	Clay till - boulders at surface, medium to dark brown
33	NE 1/4 35-3-11-2	0 - 0.3	Silt till - boulders at surface, medium brown
		0.3 - 2.5	Silt till - light brown
		2.5 - 4.6	Clay till - medium to dark brown
34	NE 1/4 35-3-11-2	0 - 1.9	Silt till - light brown
		1.9 - 4.6	Clay till - medium brown

TEST LOCATIONS 6 TO 9 INCLUSIVE

TEST LOCATION 6

Test Hole No.	Location	Depth (m)	Soil Description
35	SE 1/4 12-3-10-2	0 - 2.5	Clay till - boulders at surface, medium brown
		2.5 - 3.1	Sand - silty, moist, fine, poorly graded, medium brown
		3.1 - 4.6	Clay till - dark brown
36	SE 1/4 12-3-10-2	0 - 4.6	Clay till - boulders at surface, medium brown
37	SE 1/4 12-3-10-2	0 - 1.9	Silt till - boulders at surface, medium brown
		1.9 - 4.6	Clay till - medium to dark brown

TEST LOCATION 7

Test Hole No.	Location	Depth (m)	Soil Description
38	NW 1/4 34-2-9-2 (north side upper slope)	0 - 2.2	Gravel - silty, sandy, poorly graded, medium sized, medium brown
		2.2 - 4.6	Clay - damp, dark brown to grey
NOTE: water line running approximately 9.1 m west of test hole is lowest portion of ravine			
39	NW 1/4 34-2-9-2 (south side upper slope)	0 - 0.5	Topsoil
		0.5 - 2.7	Gravel - silty, sandy
		2.7 - 4.6	Clay till - silty, grey
40	NW 1/4 34-2-9-2 (north side upper slope)	0 - 4.6	Clay till - boulders and cobbles at 0.2 - 0.5 m, medium brown
42	NE 1/4 33-2-9-2 (north side top of slope)	0 - 5.5	Silt till - boulders at surface, light brown
		5.5 - 7.6	Clay till - medium brown
43	NW 1/4 34-2-9-2 (north side top of slope)	0 - 0.5	Topsoil
		0.5 - 2.0	Gravel - silty, trace of clay and sand, light brown
		2.0 - 3.1	Clay till - silty, medium brown
44	NW 1/4 34-2-9-2	0 - 0.7	Topsoil
		0.7 - 1.9	Sand - gravelly, light brown
		2.9 - 3.1	Clay till - medium brown

Test Pit No.	Location	Depth(m)	Soil Description
13 to 30	NE 33, NW 34 2-9-2		Area found to have a clay till profile with exception of ridge on east side of gully which consists of 4000-5000 m^3 of gravel cobbles and boulder sizes. Quanity not considered economically recoverable and does contain some shale mixed.
31	SE 4-3-9-2	0 - 0.3	Topsoil - boulders at surface
		0.3 - 2.1	Clay Till - dark grey
		2.1 - 2.4	Clay Till - greyish-blue
32	SE 4-3-9-2	0 - 0.5	Topsoil - boulders at surface
		0.5 - 1.8	Clay Till - medium brown
		1.8 - 2.4	Clay Till - light to medium brown

TEST LOCATION 8

Test Hole No.	Location	Depth (m)	Soil Description
41	SE 1/4 25-2-9-2 (north side valley bottom)	0 - 3.1	Clay - silty, medium brown to 2.2 m, dark grey to 3.1 m, trace of sand and gravel

TEST LOCATION 9

Test Pit No.	Location	Depth (m)	Soil Description
1	SW 1/4 26-2-9-2	0 - 0.4	Topsoil
		0.4 - 1.9	Gravel - well graded, sandy
		1.9 - 2.7	Sand
2-6	SW 1/4 26-2-9-2	0 - 0.4	Topsoil - boulders at surface
		0.4 - 2.7	Clay Till - medium brown
7	NW 26-2-9-2	0 - 0.6	Topsoil - boulders at surface
		0.6 - 2.4	Clay - sandy, medium brown
		2.4 - 2.7	Clay Till - medium brown
8	NW 26-2-9-2	0 - 0.3	Topsoil - boulders at surface
		0.3 - 0.8	Sand - silty, light brown
		0.8 - 2.1	Clay Till - 20% cobbles and boulders, medium brown
		2.1 - 2.4	Sand - clayey, medium brown
9	NW 26-2-9-2	0 - 0.3	Topsoil - boulders at surface
		0.3 - 1.2	Clay Till - medium brown
		1.2 - 2.3	Clay - silty, nuggetty, medium brown
10	NW 26-2-9-2	0 - 0.3	Topsoil - boulders at surface
		0.3 - 1.2	Clay Till - some sand and gravel at 1.0 - 1.2 m, medium brown
		1.2 - 1.8	Clay Till - blue grey
11	NW 26-2-9-2	0 - 0.4	Topsoil - boulders at surface
		0.4 - 1.4	Clay Till - some cobbles and boulders from 1.0 m
		1.4 - 2.1	Clay Till - blue-grey
12	NW 26-2-9-2	0 - 0.3	Topsoil - boulders at surface
		0.3 - 0.6	Clay Till - medium brown
		0.6 - 2.1	Clay Till - blue-grey

APPENDIX B

Saskatchewan of Highways & Transportation

Pit Data - Long Creek

East of Highway 35

	Pit No.	Location	Comments
1.	62E - 101	NE 36-2-14-2	Large outwash. Dept owned. Gravel 63.300 m^3. Sand 63,300 m^3.
2.	62E - 108	NW 12-2-13-2	Outwash deposit. Dept. owned. Gravel 35,600 m^3. Sand 158,800 m^3.
3.	62E - 29	NW 35-2-12-2	Private pit. No test information available.
4.	63E - 31	SW 25-1-12-2	Private pit. No test information available.
5.	63E - 48	NE 4 and SW 9 1-11-2	Returned to owner.
6.	62E - 40	Sec 9-1-11-2	Terrace deposit. Dept. owned. Gravel 27,600 m^3.
7.	62E - 159	N 1/2 Sec 2 Sec 3-1-11-2	Private pit. No test information available.

APPENDIX C

AGGREGATE USEAGE &
AGGREGATE PROCESSING COST

RURAL MUNICIPALITY - AGGREGATE USAGE

Rural Municipality	1986 Volume M^3	Anticipated 1987 Volume M^3	Source	Remarks
Enniskallen #3	14,909	11,469	SHT pit SE 16-1-3 N 1/2 36-1-3 Private pit SE 35-2-1	Not in study area
Coalfields #4	11,469	11,469	Frobisher pit Oxbow pit	Not in study area
Estevan #5	7,646	7,646	Local private pit	Not in study area
Cambria #6	7,646	7,646	SHT pit Municipal pit Private pit 1 small new pit 16-3-10 in Souris Valley	Lots of alternate sources along Long Creek
Souris Valley #7	11,698	9,940	Private pits 1 small pit in Souris Valley	3 to 6 other pits in area
Moose Creek #33	6,117	6,117	-23-5-2 -29-5-2	1) 8 or 9 other pits in R.M. 2) both pits in study
Browning #34	7,646	7,646	From R.M. of Brock From R.M. of Moose Creek	Not in study area In study area
Benson #35	5,352	5,352	From R.M. of Golden West From R.M. of Brock	Not in study area
Cymri #36	15,292	15,292	2 pits in Souris Valley (SHT) 1 private pit	1 or 2 other pits in R.M.

RURAL MUNICIPALITY - AGGREGATE USAGE (CONTINUED)

Rural Municipality	1986 Volume M^3	Anticipated 1987 Volume M^3	Source	Remarks
Lomond #37	7,646	7,646	1/2 R.M. of Cymri 1/2 R.M. of Laurier	In study area Not in study
Moose Mountain #63	15,292	15,292	35-8-3 22-8-1 5-7-1 31-9-1	Not in study area Lots of other pits in area
Brock #64	12,998	12,998	4 R.M. pits 2 SHT pits	Not in study Lots of other pits
Tecumseh #65	12,233	9,350	23-9-7	Not in study Some other pits
Griffin #66	9,175	9,175	32-10-8 25-12-?	Not in study area In study area No gravel in R.M.
Weyburn #67	8,415	8,415	Radville Area	Not in study area
TOTAL	153,295	145,266		

1987 - 38,228 estimated from within study area

1987 - 107,038 estimated from outside study area

SASKATCHEWAN HIGHWAYS & TRANSPORTATION DATA ON AGGREGATE USAGE
RAFFERTY RESERVOIR AREAS
(Period 1982 - 1986 Inclusive)

Pit No.	Department Usage (m^3)	Permittees Usage
26	-	-
30	-	-
34	-	1,800 (1983)
35	-	-
37	-	-
39	-	-
53	-	-
56	-	-
114	-	-
133	-	-
134	-	-
141	6,369 (1984) 19,196 (1985)	-
146	-	-
147	-	-
148	-	-
149	-	-
151	41,958 (1984)	-
153	-	-
156	-	-
163	-	-
Total Usage	67,523	1,800

Pit 151 outside reservoir area and total usage by SHT is 67,523 less 41,958 or 25.565 m^3 for period.

Total usage by permittees is 1,800 m^3.

CITIES - AGGREGATE USAGE

City of Estevan

1) 7,646 - 11,469 m^3	Fill Gravel	From Own Pit Not In Study Area
2) 6,881 m^3	Base & Asphalt Aggregate	Local Pits

City of Weyburn

Total Usage - 5,352 m^3 All From Radville Area For Past 5 to 6 Years

VILLAGES & TOWNS – AGGREGATE USAGE

	Population	Volume (per year) M^3	Source	Remarks
Ralph	?	–	–	6 house town
Halbrite	125	153	Souris River Valley	
Midale	564	536	?	
Macoun	190	39		
Hitchcock	50	23	Local	
Goodwater	50	16	Local	
Tribune	70	–	–	–
Bromhead	?	–	–	–
Outram	?	–	–	–
Torquay	320.	77	Local	
Griffin	?	–	–	–
Stoughton	750	383	Local	Town mostly paved
Benson	100	31 - 39	Local	
Kisbey	228	77	Local	
Arcola	493	383	Local	Complete major paving in past
Carlyle	1100	612	Local	
Manor	370	77	Local	Complete major paving in past
Redvers	859	77	Local	Complete major paving in past
Alida	169	31	Local	Complete major paving in past

VILLAGES & TOWNS - AGGREGATE USAGE (CONTINUED)

	Population	Volume (per year) M^3	Source	Remarks
Fillmore	370	230	Francis & Corning	-
Carnduff	1043	77	Local	Complete major paving in past
Oxbow	1200	459	Local	* Proposed 1987 paving project
Glen Ewen	168	77	Local	Complete town paving in past
Alameda	320	77	Oxbow & Local	Complete town paving in past
Bienfait	835	536	Local	Complete town paving in past
Lampman	650	306	Local	Complete town paving in past
		4282		

Total is less than 4588 m^3/year

* Oxbow has only one major project proposed (approximately 9,175 m^3) of crushed base and aggregate.

1987 - 200 m^3 estimated from within study
area

1987 - 5390 m^3 estimated from outside study
area

MISCELLANEOUS - AGGREGATE USAGE

User	Location	M^3 Volume	Source	Remarks
Bedecs Ready Mix	Redvers & Carlyle	1,147	North of Redvers	
Giroux Ready Mix	Estevan & Stoughton	45,874	Stoughton	(Rock & Sand)
Swayze Redi Mix	Carnduff	1,912	South of Oxbow	
Peterson Redi Mix	Estevan	11,469	South of Oxbow & Local	
Giroux Redi Mix	Weyburn	11.469	Stoughton	
Larsen's Redi Mix	Weyburn	19,114	Radville	
CNR	Various	Varies	Man. & Ont.	
CPR	Various	Varies	Various	(Will not need ballast until 1990-1995)
SPC Boundary Dam	Estevan	1,530	Local Pit	
Prairie Coal	Estevan	2,294	Local Pit	
M & S Coal	Estevan	2,294	Local Pit	
Oilfields	Various	3,823	Various	
Sask. Hwy. & Trans.	-	51,626	(see separate sheet)	

AGGREGATE PROCESSING COSTS

UNIT COSTS (IMPERIAL)

* Stripping Cost	$ .50/yd^3
Crushing Cost	$3.00 - $4.00/yd^3
Washing Cost	$3.00 - $4.00/yd^3
Screening Cost	$1.50/yd^3
Hauling Cost	$ .20/ton-mile (min. 5 miles)
Stockpiling Cost	$1.00/yd^3
Reclamation Cost	$ .50/yd^3

* Varies due to depth of overburden and depth of gravel beneath.

UNIT COSTS (METRIC)

Stripping Cost	$ .66/m^3
Crushing Cost	$3.93 - $5.24/m^3
Washing Cost	$3.93 - $5.24/m^3
Screening Cost	$1.97/m^3
Hauling Cost	$ .13/tonne-km (min. 8 km)
Stockpiling Cost	$1.31/m^3
Reclamation Cost	$ .66/m^3

SUMMARY OF SOURIS VALLEY USERS
VILLAGES & TOWNS - AGGREGATE USAGE

	Population	Volume (per year) M^3	Source	Remarks
Halbrite	125	153	Souris River Valley	-

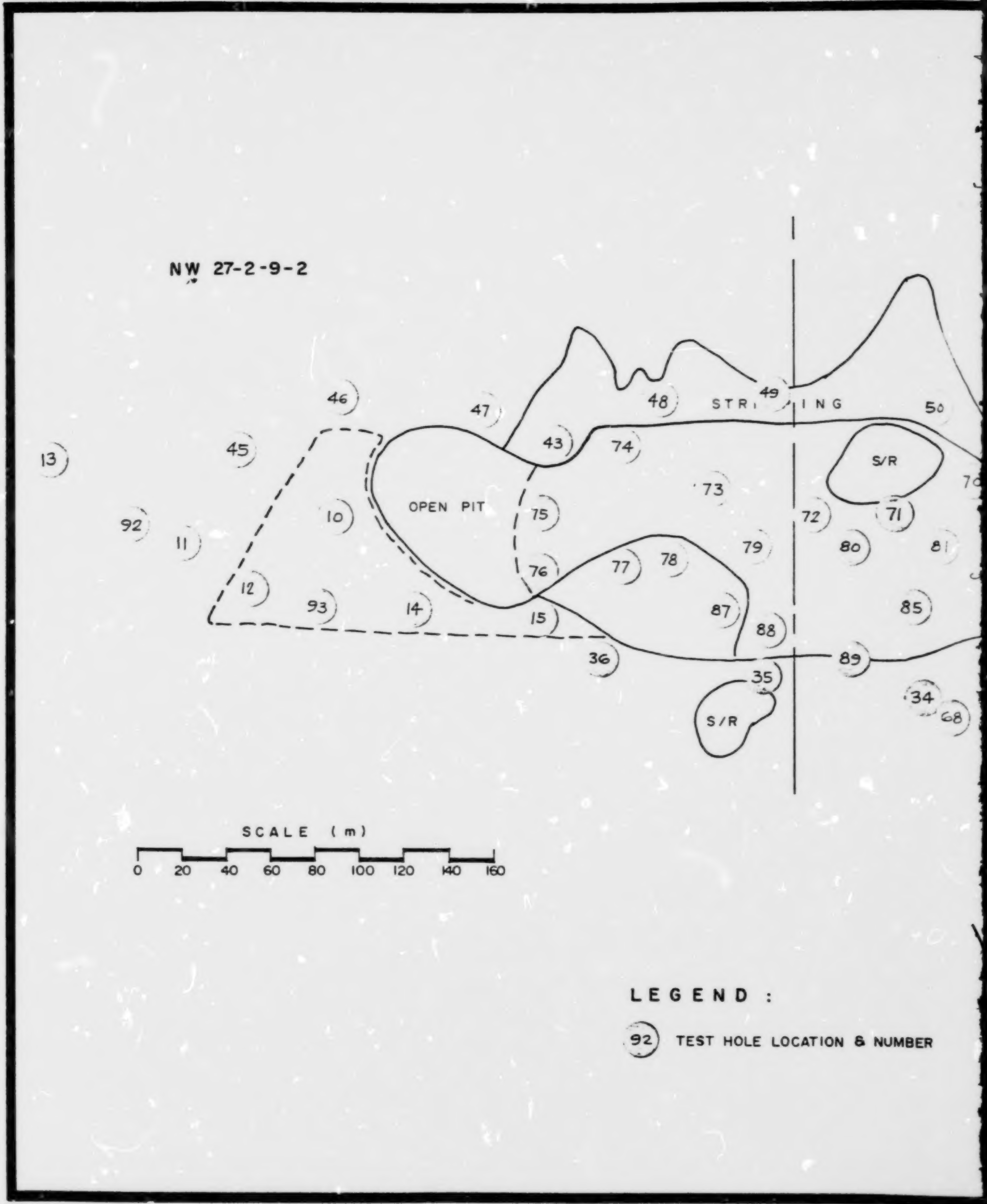
RURAL MUNICIPALITY - AGGREGATE USAGE

Rural Municipality	1986 Volume M^3	Anticipated 1987 Volume M^3	Source	Remarks
Cambria #6	7,646	7,646	SHT pit Municipal pit Private pit 1 small new pit 16-3-10 in Souris Valley	Lots of alternate sources along Long Creek
Souris Valley #7	11,698	9,940	Private pits 1 small pit in Souris Valley	3 to 6 other pits in area
Cymri #36	15,292	15,292	2 pits in Souris Valley (SHT) 1 private pit	1 or 2 other pits in R.M.
Lomond #37	7,646	7,646	1/2 R.M. of Cymri 1/2 R.M. of Laurier	In study area Not in study
Griffin #66	9,175	9,175	32-10-8 25-12-?	Not in study area In study area No gravel in R.M.

APPENDIX D

DETAILS OF SHT PIT 62E - 141

- Site Plan
- Logs and Laboratory Analysis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47
48
49
50
13
45
43
74
73
OPEN PIT
S/R
70
92
11
10
75
72
71
80
81
79
76
77
78
12
93
14
15
87
88
85
36
89
35
34
68
S/R
STRI ING
SCALE (m)
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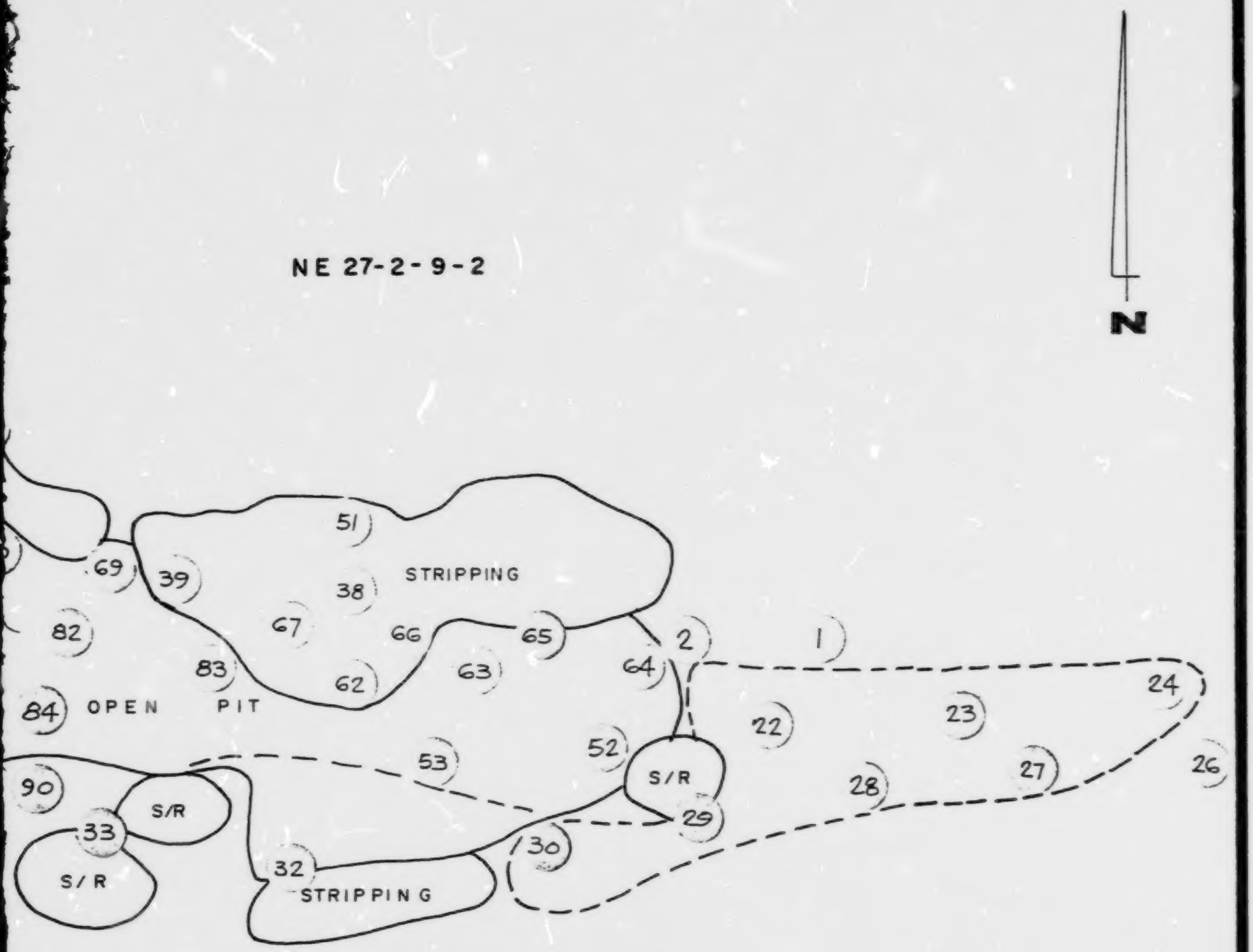
20
40
60
80
100
120
140
160
LEGEND :
92
TEST HOLE LOCATION & NUMBER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N
51
STRIPPING
69
39
38
82
67
66
65
2
1
64
83
63
62
24
84
OPEN PIT
22
23
52
53
S/R
26
27
90
28
S/R
29
33
30
32
S/R
STRIPPING

Hardy BBT Limited
CONSULTING ENGINEERING & PROFESSIONAL SERVICES

GRANULAR RESOURCE STUDY
RAFFERTY RESERVOIR, SASKATCHEWAN

Scale : SHOWN
Date : APRIL '87
Drawn By : W. T.
Approved By :
Drawing No : JX-60048-D1

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                           SASKATCHEWAN  DEPARTMENT  OF  HIGHWAYS  AND  TRANSPORTATION     GRAVEL  PIT  LOG
PIT NO. 62E-141   LAND LOC. N  27-002 -09 -2   TESTED   OCT 30 1973      SUPERVISOR JOHN MOULY        RUN ON MAR. 19 1987   PAGE   1

        LEGEND:   HOLE NO.     : E-EAST S-SOUTH W-WEST N-NORTH D-DRILL
                  WET DRY N.S  : WET - WASHED SAMPLE     DRY - DRY SAMPLE     N.S - NOT SAMPLED     CAL - CALGON USED
                  WATER TABLE  : NEGATIVE VALUE WHEN WATER TABLE ABOVE GROUND LEVEL --- ESTIMATE ONLY
                  80-160       : % RETAINED ON 80 MM --- ESTIMATE ONLY
                  OVER SIZE    : % OVERSIZE MATERIAL (PLUS 160 MM) *** ESTIMATE ONLY

HOLE   MATERIAL      SAMP.DEPTH                  PERCENTAGE PASSING STANDARD CANADIAN METRIC SIEVES                     WET  SAND  WATER          OVER
 NO.   DESC.    TYPE FROM  TO      80     40     18   12.5      5    2.0    900    400    250    160     71     50  DRY  EQVT  TABLE  80-160  SIZE
                     *--METRES-*------------ MILLIMETRES ---------------*--------------- MICROMETRES ----------------*N.S*      *METRES*   %     * % *
------------------------------------------------------------------------------------------------------------------------------------------------------
   1   TOPSOIL       0.0- 0.6                                                                                      N.S
       CLAY          0.6- 2.1                                                                                      N.S
       SILT          2.1- 3.0                                                                                      N.S

   2   TOPSOIL       0.0- 0.3                                                                                      N.S
       CLAY          0.3- 2.1                                                                                      N.S
       GRAVEL     2  2.1- 3.4   100.0   96.3   87.4   82.1   54.0   31.8   16.8    9.9           4.9    4.2         WET          2.7

  10   TOPSOIL       0.0- 0.2                                                                                      N.S
       GRAVEL     1  0.2- 1.2   100.0   91.6   75.3   67.5   44.3   26.8   11.0    5.2           3.1    2.7         WET
       SAND       4  1.2- 2.4                 100.0   97.5   89.4   76.3   62.7   17.3           2.9    2.5         WET
       GRAVEL     4  2.4- 3.4                 100.0   94.6   81.9   64.8   44.0   17.9           5.4    4.5         WET

  11   TOPSOIL       0.0- 0.2                                                                                      N.S
       GRAVEL     2  0.2- 2.4   100.0   79.4   50.9   41.3   23.0   14.9   10.3    7.8           4.9    4.1         WET

  12   TOPSOIL       0.0- 0.2                                                                                      N.S
       GRAVEL     3  0.2- 1.2   100.0   98.3   91.1   82.1   70.1   56.2   38.7   15.1           7.2    5.6         WET
       GRAVEL     2  1.2- 3.4   100.0   93.6   70.3   65.0   47.5   31.5   19.3   10.6           5.6    4.7         WET  38.0

  13   TOPSOIL       0.0- 0.3                                                                                      N.S
       ROCK          0.3- 1.2                                                                                      N.S
       SILT          1.2- 1.8                                                                                      N.S

  14   TOPSOIL       0.0- 0.3                                                                                      N.S
       GRAVEL     3  0.3- 1.8          100.0   91.1   86.4   65.5   50.4   39.4   14.2           6.8    6.2         WET
       GRAVEL     1  1.8- 3.4   100.0   93.0   73.6   68.8   52.5   40.5   25.7    7.3           2.8    2.5         WET  55.0

  15   TOPSOIL       0.0- 0.2                                                                                      N.S
       GRAVEL     2  0.2- 1.2   100.0   98.3   84.7   75.5   44.9   29.6   20.9   12.7           5.8    4.9         WET
       SAND       5  1.2- 2.1                 100.0   98.5   94.5   89.2   69.1   13.2           3.0    2.6         WET
       GRAVEL     3  2.1- 3.7   100.0   95.1   84.1   78.6   60.8   48.6   34.8   11.4           3.8    3.0         WET  54.0

  22   TOPSOIL       0.0- 1.2                                                                                      N.S
       GRAVEL     2  1.2- 2.7   100.0   77.8   56.5   54.1   42.1   31.2   18.1   10.3           6.2    5.3         WET          1.7       8    17

  23   TOPSOIL       0.0- 1.5                                                                                      N.S
       GRAVEL     4  1.5- 2.4   100.0   84.8   68.5   62.1   53.0   44.4   31.8   17.7          13.0   12.0         WET          1.7       5    12

  24   TOPSOIL       0.0- 1.1                                                                                      N.S
       GRAVEL     2  1.1- 2.7   100.0   84.1   67.1   64.6   51.6   38.0   24.8   14.4           7.5    6.7         WET          1.8       7    12

  25   TOPSOIL       0.0- 0.3                                                                                      N.S
       CLAY          0.3- 1.8                                                                                      N.S
```

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                    SASKATCHEWAN  DEPARTMENT  OF  HIGHWAYS  AND  TRANSPORTATION      GRAVEL  PIT  LOG
PIT NO. 62E-141    LAND LOC. N  27-002 -09 -2   TESTED   OCT 30 1973        SUPERVISOR JOHN MOULY        RUN ON MAR. 19 1987   PAGE   2
                                                                                                       WET SAND WATER          OVER
                                              PERCENTAGE PASSING STANDARD CANADIAN METRIC SIEVES       DRY EQVT TABLE  80-100 SIZE
HOLE MATERIAL       SAMP.DEPTH      80     40     18   12.5    5     2.0   900   400   250   160    71    50 *N.S*  . *METRES*  %    * % *
 NO.  DESC.    TYPE FROM   TO  ------------ MILLIMETRES ------------*------------ MICROMETRES ------------
                    *--METRES--*------------------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------------------------------------------------
 26   TOPSOIL        0.0- 0.6                                                                       N.S
      GRAVEL         0.6- 1.2                                                                       N.S
      CLAY           1.2- 1.8                                                                       N.S

 27   TOPSOIL        0.0- 1.4                                                                       N.S
      GRAVEL     1   1.4- 2.4 100.0  97.2  73.3  62.1  45.3  28.1  13.4   5.6          3.0   2.7    WET        1.4

 28   TOPSOIL        0.0- 0.9                                                                       N.S
      GRAVEL     1   0.9- 2.7 100.0  96.9  87.8  85.8  52.2  25.5   9.8   4.6          2.7   2.5    WET        1.7

 29   TOPSOIL        0.0- 1.1                                                                       N.S
      GRAVEL         1.1- 2.4                                                                       N.S

 30   TOPSOIL        0.0- 1.1                                                                       N.S
      GRAVEL     2   1.1- 2.4 100.0  94.6  74.8  62.1  28.2  18.7  14.8   7.3          4.5   4.2    WET 31.0   1.5

 32   TOPSOIL        0.0- 0.3                                                                       N.S
      GRAVEL     1   0.3- 2.7 100.0  90.3  67.7  56.4  33.4  23.8  17.7   8.8          2.5   1.0    WET        1.8    5     12

 33   TOPSOIL        0.0- 0.3                                                                       N.S
      TILL           0.3- 1.2                                                                       N.S
      CLAY           1.2- 2.1                                                                       N.S
      SAND       5   2.1- 3.7                          100.0  99.7  98.8  91.6        22.7  17.2    WET

 34   TOPSOIL        0.0- 0.6                                                                       N.S
      GRAVEL     1   0.6- 2.1 100.0  99.2  80.9  68.5  44.7  35.0  24.1  10.3          4.8   3.8    WET

 35   TOPSOIL        0.0- 0.3                                                                       N.S
      ROCK           0.3- 1.8                                                                       N.S

 36   TOPSOIL        0.0- 0.6                                                                       N.S
      GRAVEL     1   0.6- 2.1 100.0  88.8  62.0  51.2  37.3  30.0  23.7  11.3          4.2   3.3    WET
      ROCK           2.1- 3.0                                                                       N.S

 38   TOPSOIL        0.0- 2.4                                                                       N.S
      GRAVEL     4   2.4- 3.7 100.0  95.4  81.0  75.5  54.5  37.2  22.7  17.1         11.6   9.2    WET

 39   TOPSOIL        0.0- 0.9                                                                       N.S                7      5
      GRAVEL     1   0.9- 3.7 100.0  85.0  62.2  51.1  27.9  14.0   5.2   3.0          2.0   1.6    WET

 43   TOPSOIL        0.0- 2.0                                                                       N.S
      GRAVEL     2   2.0- 3.7 100.0  98.2  86.6  76.1  49.9  32.8  19.5  13.0          7.3   6.3    WET

 45   TOPSOIL        0.0- 0.6                                                                       N.S
      SILT           0.6- 1.2                                                                       N.S
      GRAVEL     3   1.2- 2.4        100.0  91.5  83.9  50.8  32.5  24.8  19.2          4.2   3.0    WET
      SAND       2   2.4- 3.7        100.0  91.1  81.7  53.9  34.8  25.5  17.8          4.6   3.2    WET

 46   TOPSOIL        0.0- 0.3                                                                       N.S
      SILT           0.3- 1.5                                                                       N.S
      SAND      NG   1.5- 3.4                          100.0  99.5  99.0  97.3        81.3  52.1    WET
```

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                              SASKATCHEWAN  DEPARTMENT  OF  HIGHWAYS  AND  TRANSPORTATION      GRAVEL  PIT  LOG
PIT NO. 62E-141    LAND LOC. N  27-002 -09 -2   TESTED   OCT 30 1973          SUPERVISOR JOHN MCULY          RUN ON MAR. 19 1987   PAGE   3
 HOLE MATERIAL          SAMP.DEPTH                    PERCENTAGE PASSING STANDARD CANADIAN METRIC SIEVES              WET SAND WATER          OVER
  NO.  DESC.   TYPE  FROM   TO       80      40     18   12.5     5     2.0    900    400    250    160     71     50 DRY EQVT TABLE  80-160 SIZE
                     *--METRES-*------------ MILLIMETRES -----------*----------- MICROMETRES ------------*N.S*     *METRES*   %     * % *
-----------------------------------------------------------------------------------------------------------------------------------------------
 47    TOPSOIL              0.0- 0.6                                                                       N.S
        SILT                0.6- 1.5                                                                       N.S
        SAND         6      1.5- 3.4                               100.0   99.8   99.5   98.1          36.4   19.1      WET
 48    TOPSOIL              0.0- 0.3                                                                       N.S
        SILT                0.3- 1.5                                                                       N.S
        SAND         5      1.5- 3.4                       100.0   99.7   99.6   93.2   82.1          26.0   16.5      WET
 49    TOPSOIL              0.0- 1.2                                                                       N.S
        SAND         5      1.2- 3.0                               100.0   99.5   97.4   63.5          22.3   15.1      WET
 50    TOPSOIL              0.0- 0.9                                                                       N.S
        CLAY                0.9- 3.0                                                                       N.S
 51    TOPSOIL              0.0- 0.3                                                                       N.S
        TILL                0.3- 2.1                                                                       N.S
        GRAVEL       3      2.1- 2.7       100.0   86.9   79.8   61.7   49.7   40.9   23.4           4.0    2.7      WET
        SILT                2.7- 3.4                                                                       N.S
```

SASKATCHEWAN DEPARTMENT OF HIGHWAYS AND TRANSPORTATION GRAVEL PIT LOG

PIT NO. 62F-141 LAND LOC. N 27-002 -09 -2 TESTED AUG 30, 1977 SUPERVISOR G WASYLIW RUN ON MAR. 19 1987 PAGE 4

HOLE NO.	MATERIAL DESC.	TYPE	SAMP. DEPTH FROM TO *--METRES--*	PERCENTAGE PASSING STANDARD CANADIAN METRIC SIEVES 80	40	18	12.5	5	2.0 MILLIMETRES	900	400	250	160	71	50 MICROMETRES	WET DRY *N.S*	SAND EQVT	WATER TABLE *METRES*	80-160 %	OVER SIZE * % *
52	GRAVEL	1	0.0- 2.0	100.0	80.4	61.1	56.0	38.0	26.3	15.4	7.8		3.2	2.5		WET	63.0	1.0	15	15
53	GRAVEL	1	0.0- 2.0	100.0	96.9	76.0	66.5	41.3	21.6	11.6	5.7		2.6	2.1		WET	62.5	1.0	10	17
62	GRAVEL	1	0.0- 2.0	100.0	96.6	81.1	75.9	56.2	33.5	10.8	4.8		2.6	2.2		WET	75.0	.5	2	
63	GRAVEL	1	0.0- 1.9	100.0	99.3	82.5	74.5	43.6	19.9	5.6	3.2		1.8	1.5		WET		.2		
64	TOPSOIL		0.0- 1.1													N.S				
	GRAVEL	1	1.1- 2.7	100.0	88.5	68.4	59.6	38.1	21.3	9.0	5.5		3.7	3.1		WET	51.4	2.0		2
65 N	GRAVEL	1	0.0- 3.5	100.0	93.1	81.0	74.4	55.3	29.2	7.4	3.8		2.3	1.9		WET		2.5		
65 S	GRAVEL	1	0.0- 2.5	100.0	93.1	81.0	74.4	55.3	29.2	7.4	3.8		2.3	1.9		WET		1.5		
66	GRAVEL	1	0.0- 2.2	100.0	95.8	78.5	67.4	40.9	23.1	11.9	6.8		4.0	3.3		WET	55.3	1.4		
67	TOPSOIL		0.0- 3.3													N.S		3.2		

PIT NO. 62E-141 LAND LOC. N 27-002 -09 -2 SASKATCHEWAN DEPARTMENT OF HIGHWAYS AND TRANSPORTATION GRAVEL PIT LOG
TESTED OCT 82 SUPERVISOR M TAIT RUN ON MAR. 19 1987 PAGE 5

HOLE NO.	MATERIAL DESC.	TYPE	SAMP. DEPTH FROM TO *--METRES--*	80	40	18	12.5	5	2.0	900	400	250	160	71	50	WET DRY *N.S*	SAND EQUT	WATER TABLE *METRES*	80-160 %	OVER SIZE * % *
				PERCENTAGE PASSING STANDARD CANADIAN METRIC SIEVES — MILLIMETRES						MICROMETRES										
68	GRAVEL		0.0- 0.5													N.S				
	TOPSOIL		0.5- 1.0													N.S				
	SAND	5	1.0- 1.8			100.0	94.4	91.9	89.7	85.4	37.7		5.2	3.3		WET				
	GRAVEL	3	1.8- 2.6		100.0	83.7	74.9	55.6	49.4	41.7	16.4		5.8	5.3		WET			3	1
	GRAVEL	1	2.6- 4.3	100.0	93.0	69.3	56.7	34.4	27.8	21.0	7.3		2.5	2.1		WET		2.6	5	20
69	GRAVEL	1	0.0- 1.7		100.0	90.0	88.7	56.0	27.6	13.9	6.9		4.5	3.8		WET	58.6		1	3
	SAND	5	1.7- 3.6			100.0	97.9	94.2	90.1	87.9	66.5		21.3	15.9		WET	21.3			
70	GRAVEL	3	0.0- 3.1	100.0	97.2	87.9	83.5	68.2	46.7	28.7	9.8		5.8	4.8		WET		1.5	2	3
71	GRAVEL	2	0.0- 1.2		100.0	69.9	66.4	40.2	22.2	14.5	10.7		7.7	6.1		WET	25.8	1.2	4	1
	GRAVEL	1	1.2- 3.2	100.0	81.6	79.0	69.4	43.8	16.7	6.8	4.5		3.2	2.6		WET	58.6		5	5
72	GRAVEL	3	0.0- 1.3	100.0	97.6	76.7	71.4	43.9	22.7	15.0	11.2		8.5	7.5		WET	21.2	1.3	5	2
	GRAVEL	1	1.3- 3.1	100.0	73.3	51.3	46.9	24.5	10.4	4.9	2.8		1.7	1.5		WET			5	20
	CLAY		3.1- 3.5													N.S				
73	GRAVEL	3	0.0- 2.5	100.0	95.6	83.8	80.2	70.0	47.8	17.8	7.8		4.9	4.2		WET		.6	2	1
74	GRAVEL	1	0.0- 1.5	100.0	96.9	93.7	88.4	58.8	35.6	19.2	8.9		3.1	2.6		WET	56.8		3	3
	GRAVEL	1	1.5- 3.2	100.0	93.4	70.3	55.4	34.2	14.0	6.9	5.0		3.8	2.6		WET	46.3		3	1
	SAND		3.2- 3.7													N.S				
75	GRAVEL	2	0.0- 1.9	100.0	95.1	89.3	83.6	67.6	42.3	20.3	10.1		4.3	3.4		WET			2	1
	GRAVEL	2	1.9- 3.3	100.0	83.7	57.1	47.8	29.3	17.7	11.9	8.5		5.8	4.6		WET		2.6	7	20
	GRAVEL	1	3.3- 4.2	100.0	94.5	69.7	59.4	41.8	26.3	16.6	9.0		2.0	1.5		WET			3	7
76	GRAVEL	1	0.0- 2.1	100.0	81.1	69.6	66.4	49.8	26.9	15.6	9.6		5.1	3.8		WET	39.4		5	10
	GRAVEL	1	2.1- 3.2	100.0	90.1	72.5	60.4	38.6	21.6	12.8	6.5		2.7	2.2		WET	41.7	2.1	5	20
	CLAY		3.2- 3.5													N.S				
77	GRAVEL	2	0.0- 2.1	100.0	83.0	56.4	50.7	34.8	23.5	15.6	8.3		5.4	4.6		WET		.8	10	60
78	GRAVEL	2	0.0- 0.9	100.0	88.2	69.7	65.5	40.9	19.5	12.5	9.5		7.5	6.7		WET	18.6	.9	5	5
	GRAVEL	1	0.9- 2.5	100.0	87.1	72.8	61.9	38.5	15.0	6.3	3.7		2.3	1.8		WET	26.7		5	5
	CLAY		2.5- 2.9													N.S				
79	GRAVEL	3	0.0- 0.9	100.0	94.3	78.8	73.5	53.0	34.4	21.2	13.5		9.0	7.5		WET			5	5
	GRAVEL	1	0.9- 2.1	100.0	98.7	83.6	68.1	33.4	14.4	8.0	5.1		2.9	2.3		WET			5	5
	CLAY		2.1- 2.6													N.S				
80	GRAVEL	4	0.0- 1.2	100.0	96.3	93.4	90.4	82.4	58.2	22.6	3.9		2.7	2.3		WET	81.4		1	3
	GRAVEL	4	1.2- 2.8	100.0	97.3	91.7	91.7	84.9	72.1	45.0	13.9		2.7	2.0		WET	67.9		1	5
81	GRAVEL	4	0.0- 1.2			100.0	99.2	85.5	51.4	15.9	3.3		2.0	1.6		WET			2	5
	GRAVEL	3	1.2- 3.3		100.0	93.8	90.4	73.6	50.1	25.9	7.9		2.8	2.2		WET			2	10
82	GRAVEL	2	0.0- 0.9	100.0	92.5	71.9	68.9	53.8	36.4	20.8	11.0		6.5	5.3		WET	49.4	.9	5	10
	GRAVEL	1	0.9- 3.1	100.0	94.6	70.1	60.9	33.4	17.3	9.0	4.2		2.1	1.5		WET	72.5		5	20

```
                          SASKATCHEWAN  DEPARTMENT  OF  HIGHWAYS  AND  TRANSPORTATION     GRAVEL  PIT  LOG
PIT NO. 62F-141    LAND LOC. N  27-002 -09 -2   TESTED   OCT 82          SUPERVISOR M TAIT           RUN ON MAR. 19 1987    PAGE   6

HOLE MATERIAL     SAMP.DEPTH ---------- PERCENTAGE PASSING STANDARD CANADIAN METRIC SIEVES ------------ WET SAND WATER ------ OVER
 NO.  DESC.  TYPE FROM  TO      80    40    18  12.5     5   2.0   900   400   250   160    71    50 DRY  EQVT TABLE 80-160  SIZE
                 *--METRES-*------------ MILLIMETRES ------------*------------ MICROMETRES -----------*N.S*     *METRES*   %    * % *
-------------------------------------------------------------------------------------------------------------------------------------
 83  GRAVEL    1  0.0- 0.9 100.0  97.4  77.9  76.5  53.0  25.8   8.2   4.4         3.5   2.9       WET            .9      3     1
     GRAVEL    1  0.9- 2.8 100.0  90.7  78.5  64.6  36.4  14.8   4.4   2.0         1.5   1.3       WET                    3     5

 84  GRAVEL    2  0.0- 1.7 100.0  87.0  71.6  65.5  46.1  27.5  16.8  11.6         6.5   4.9       WET  40.0   1.7      5    10
     GRAVEL    1  1.7- 3.5 100.0  93.1  82.9  76.1  54.4  29.8  11.6   3.8         1.8   1.4       WET  55.4            2     5

 85  GRAVEL    2  0.0- 1.9 100.0  91.7  82.4  76.5  59.9  37.5  23.5  14.9         8.2   5.9       WET  40.0   1.9      5    10
     GRAVEL    1  1.9- 2.7 100.0  96.2  76.5  69.7  41.7  22.3  12.0   5.4         3.4   2.6       WET  37.1            5     5
     GRAVEL    1  2.7- 3.5 100.0  96.0  76.8  62.5  34.8  17.9   9.8   4.7         2.0   1.4       WET  67.3           10     5

 86  GRAVEL    4  0.0- 1.2       100.0  96.3  93.9  63.0  39.8  22.4  13.5        10.2   8.7       WET  37.9   1.2            2
     GRAVEL    5  1.2- 2.9                   100.0  99.8  97.0  82.8  16.0         2.3   2.0       WET                    1     5

 87  GRAVEL    3  0.0- 1.2 100.0  85.3  76.2  67.7  48.9  30.9  19.7  12.2         8.4   7.8       WET  43.6            5    40
     GRAVEL    4  1.2- 2.6 100.0  91.9  61.0  57.1  41.0  27.8  20.0  15.6        11.6   9.2       WET  17.3   2.6      5    40
     GRAVEL    2  2.6- 3.5 100.0  91.4  74.1  71.5  48.4  30.6  19.9  11.9         7.6   6.7       WET                   10    20

 88  GRAVEL    2  0.0- 2.2 100.0  93.8  74.5  74.5  56.3  35.7  21.3  13.2         7.6   5.8       WET  39.7   2.2     10    30
     GRAVEL    2  2.2- 3.5 100.0  84.9  56.6  52.6  34.9  23.5  15.8   9.2         6.4   5.4       WET  23.7           10    30

 89  GRAVEL    3  0.0- 2.3 100.0  98.7  79.8  75.6  53.1  36.0  24.8  15.9         9.9   7.1       WET  24.9   2.3      2     8
     GRAVEL    1  2.3- 3.7 100.0  90.9  67.5  57.9  41.4  26.7  14.2   7.3         4.8   3.9       WET                    5    10

 90  GRAVEL    2  0.0- 2.5 100.0  93.2  73.3  63.5  40.5  26.9  18.7  10.1         5.9   4.7       WET  41.1   2.1      5    20
     ROCK         2.5- 3.3                                                                         N.S

 92  GRAVEL    4  0.0- 1.6 100.0  85.9  72.6  70.4  56.5  42.2  33.8  26.3        15.5  10.1       WET  28.2           10    60
     GRAVEL    2  1.6- 4.7 100.0  82.5  66.0  63.5  46.6  28.3  19.0  12.5         7.1   5.3       WET                   10    60
     GRAVEL    4  4.7- 5.5 100.0  91.6  72.7  59.4  42.5  29.1  21.4  17.7        14.3  12.0       WET         5.1     10    10

 93  TOPSOIL      0.0- 0.2                                                                         N.S
     GRAVEL    4  0.2- 1.1 100.0  97.0  93.1  90.0  81.3  69.1  52.7  15.5         5.3   3.7       WET  36.4
     GRAVEL    1  1.1- 2.7 100.0  89.5  72.6  68.8  55.5  39.9  25.4   5.8         1.8   1.3       WET  58.1            2
     GRAVEL    1  2.7- 3.7 100.0  89.4  76.2  70.1  55.1  39.2  25.0   9.7         5.3   3.7       WET         3.7     10    15
     GRAVEL    1  3.7- 4.5 100.0  87.9  73.6  64.6  48.2  29.2  17.3   8.0         4.6   3.4       WET                   10    15
```

APPENDIX E

TERMS OF REFERENCE
FOR STUDY

REQUEST FOR PROPOSALS

FOR

GRAVEL STUDY

FOR

RAFFERTY/ALAMEDA PROJECTS

Souris Basin Development Authority
Estevan, Saskatchewan
2711j

1.0 INTRODUCTION

The Rafferty and Alameda Dams and Reservoirs to be constructed in Southern Saskatchewan, will flood several granular deposits. Souris Basin Development Authority (SBDA) require a Gravel Study to locate granual deposits in the flood zone and investigate the quality, quantity and salvage costs associated with each deposit.

The study will start 1987 February 15 and must be completed no later than 1987 March 20. The product of the study would be a report addressing deposits located and investigated and deposits slated for salvage including qualities, quantities and costs.

Six (6) copies of the proposal should be submitted to G. Hood in accordance with the covering letter.

2.0 TERMS OF REFERENCE

The Gravel Study shall include the following:

a) Locate existing and potential granular deposits within the reservoir full supply levels through discussions with:

  - Souris Basin Development Authority
  - Saskatchewan Power (Mollard's report)
  - Saskatchewan Department of Highways & Transportation
  - Major local users, including rural municipalities, towns, villages, cities and contractors

  Locate the deposits on 1:50,000 mapping.

b) Determine other existing potential granular sources near the reservoir, through discussions with parties as listed above. Tabulate and map this information.

c) Determine annual granular consumption and unit prices incurred by the major local users listed above.

d) Conduct a soils investigation for each deposit within the Reservoirs to determine quantity, quality and overburden and granular depths. Tabulate this information.

e) Recommend criteria for economic salvage based on potential salvage costs versus existing unit prices and alternate sources.

f) Estimate salvage costs for each deposit. Tabulate this information.

g) Prepare a report including:

  1. Mapping illustrating potential and existing alternate granual sources near the reservoirs.
  2. Mapping 1:50,000 illustrating potential and existing granular deposits within the reservoir FSL's.

3. Mapping 1:50,000 illustrating deposits recommended for salvage.
4. Mapping 1:5,000 illustrating test hole locations.
5. Test hole logs.
6. Tables of other sources, user consumption, existing unit price: salvage deposit qualities, quantities and salvage costs.
7. Recommended salvage criteria relative to salvage costs and alternate source costs.

3.0 GRANUAL DEPOSITS

J. D. Mollard & Associates Limited have identified several potential granular deposits within the reservoir areas.

Saskatchewan Department of Highways have mapped several potential granular deposits within the reservoir areas also.

The majority of the deposits above have not been completely investigated to qualify or disqualify them. Major local users may know of other granular deposits within the Reservoir.

4.0 PROPOSAL INFORMATION

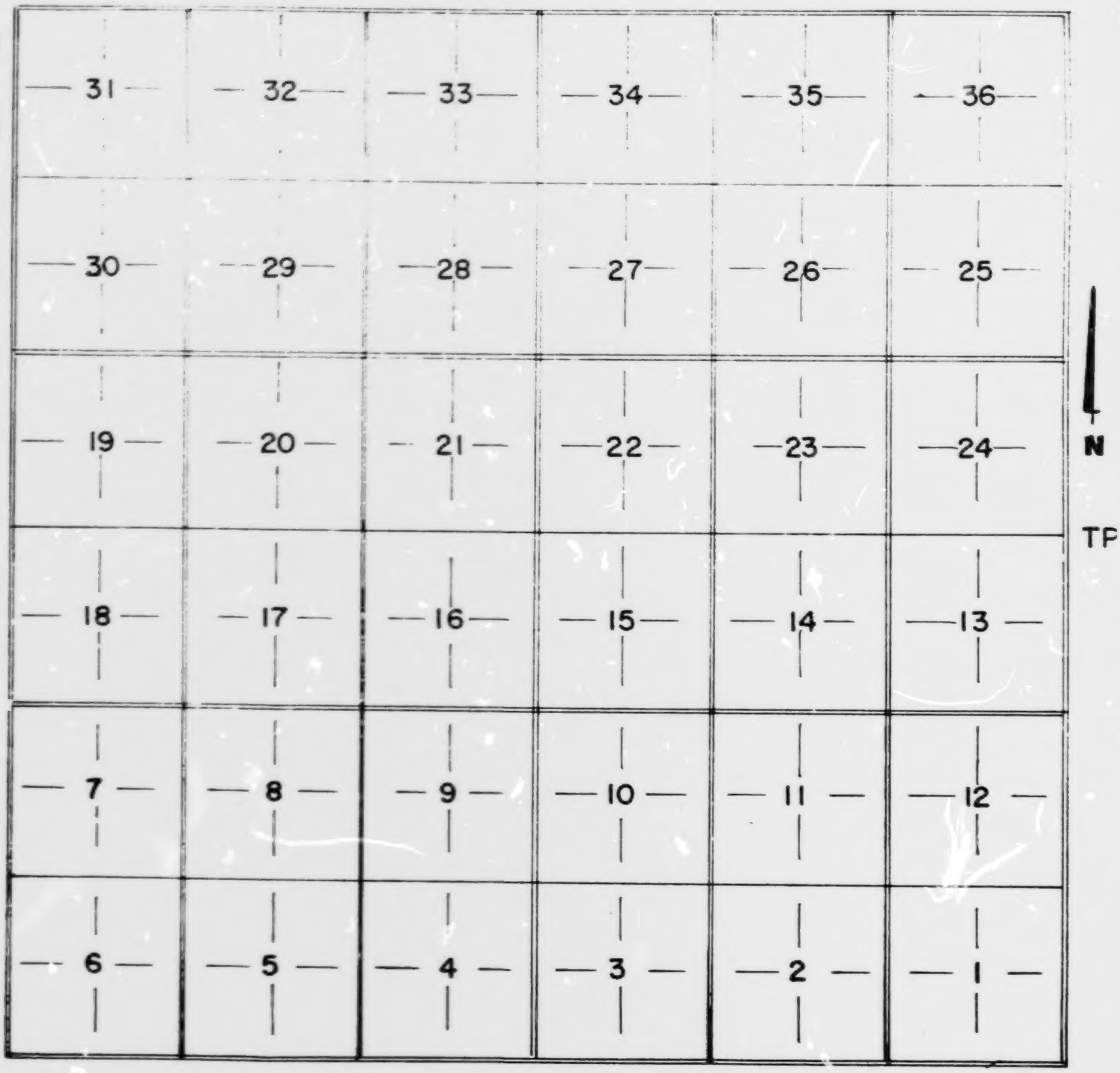
The following information should be provided with the proposal:

a) Recent related experience.
b) Resumes of key organization personnel.
c) Office location.
d) Sub-contractors or consultants proposed.
e) Proposed Soil Investigation Program.
f) Proposed course of action and scheduling.
g) Lump Sum Cost for the Study including a breakdown for each item ("a" to "g") of Section 2.0-Terms of Reference.

5.0 SBDA SERVICES

The following services will be provided by SBDA:

a) Provide 1:50,000 mapping reproducibles.
b) Provide 1:5,000, 1 m contours interval mapping reproducibles.
c) Provide potential deposit mapping prepared by Mollard and Saskatchewan Highways.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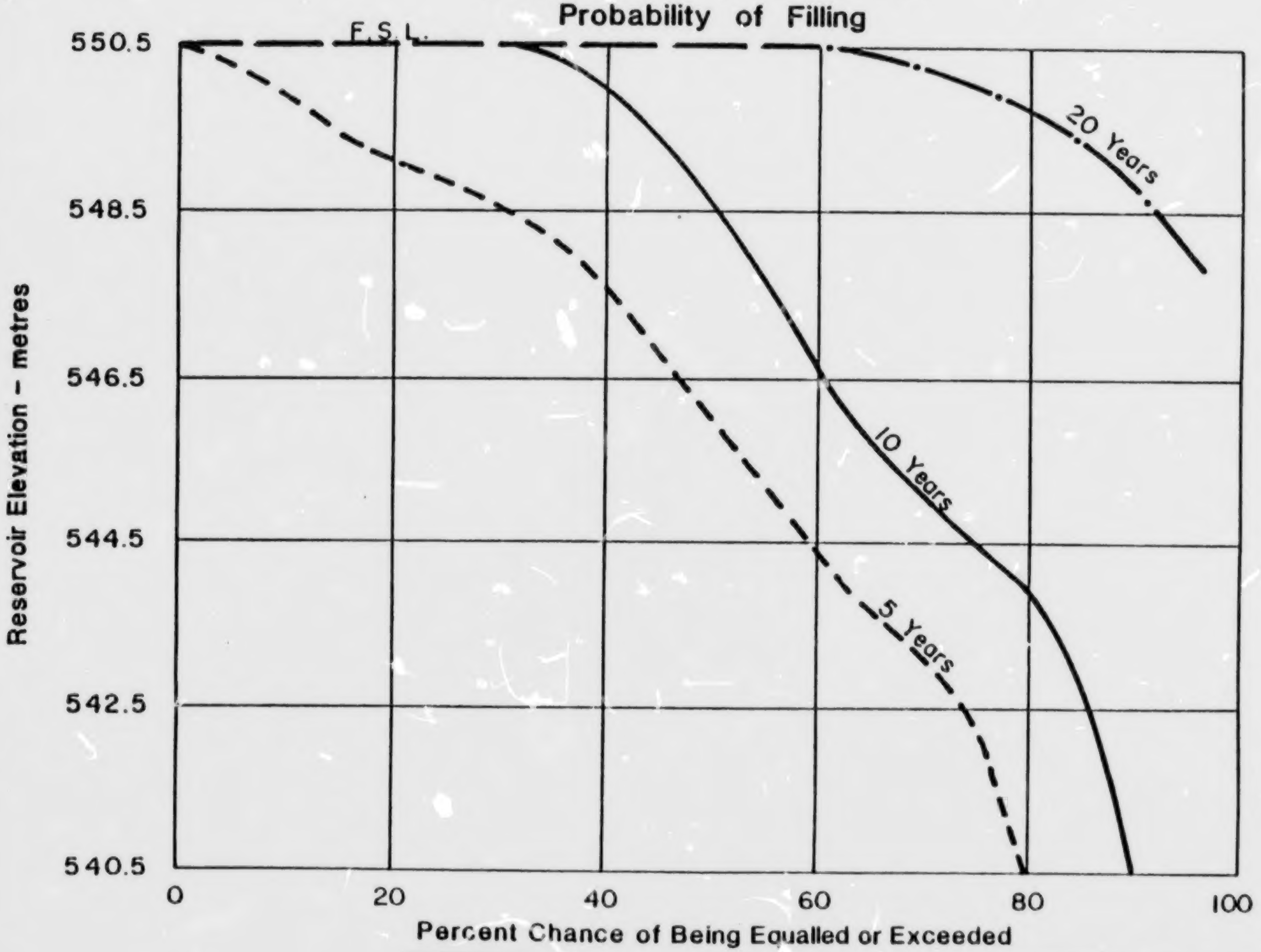
Hardy BBT Limited
CONSULTING ENGINEERING & PROFESSIONAL SERVICES

APPENDIX TWO - OIL

RAFFERTY RESERVOIR

Probability of Filling



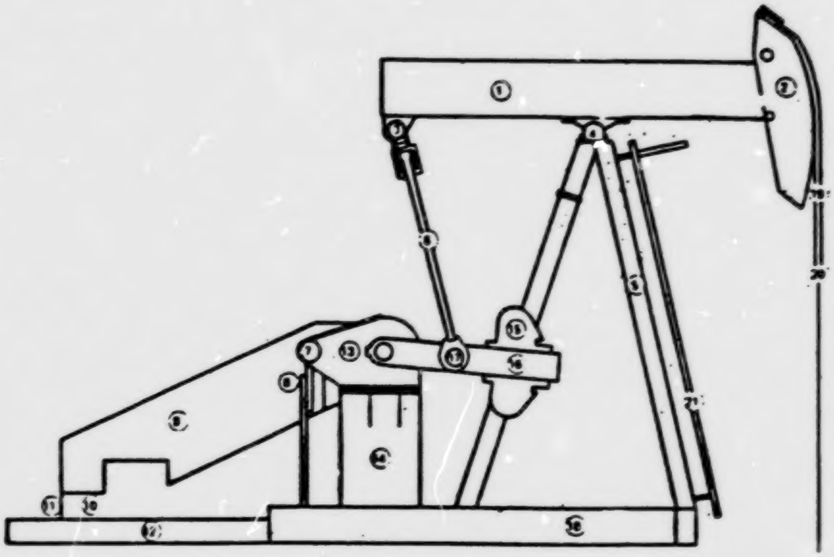
Designed by
Drawn by D. Fong
Recommended by
Approved by

SASKATCHEWAN WATER CORPORATION

Figure 1

Date May 7,1987
Sheet of
PLAN No.

FIGURE 2 - TYPICAL PUMPING UNIT



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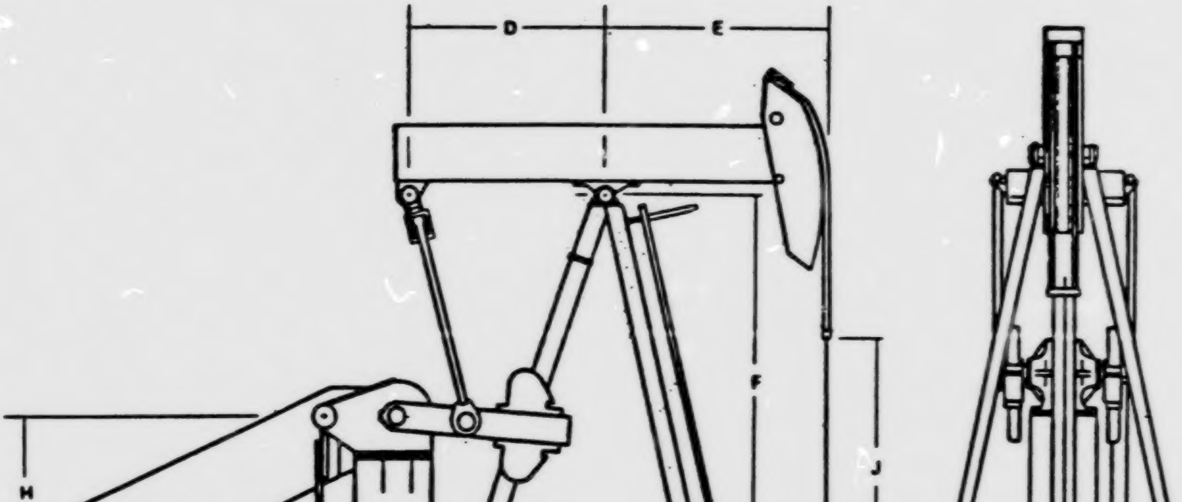
7
8
9
10
11
12
13
14
15
16
18
19
20
21

1 Walking Beam
2 Mulehead
3 Tail Bearing
4 Saddle Bearing
5 Samson Post
6 Equalizer Pitman
7 Brake
8 Reducer Sheave
9 Belt Guard
10 Slide Rails
11 Brake Lever
12 Motor Extension
13 Gear Reducer
14 Reducer Sub-Base
15 Weights
16 Crank
17 Wrist Pin Assembly
18 Frame
19 Wireline
20 Polished Rod Hanger
21 Samson Post Ladder



D
E
F
H
J
G
B
A
C
K
L

FIGURE 3 - TYPICAL PUMPING WELLHEAD

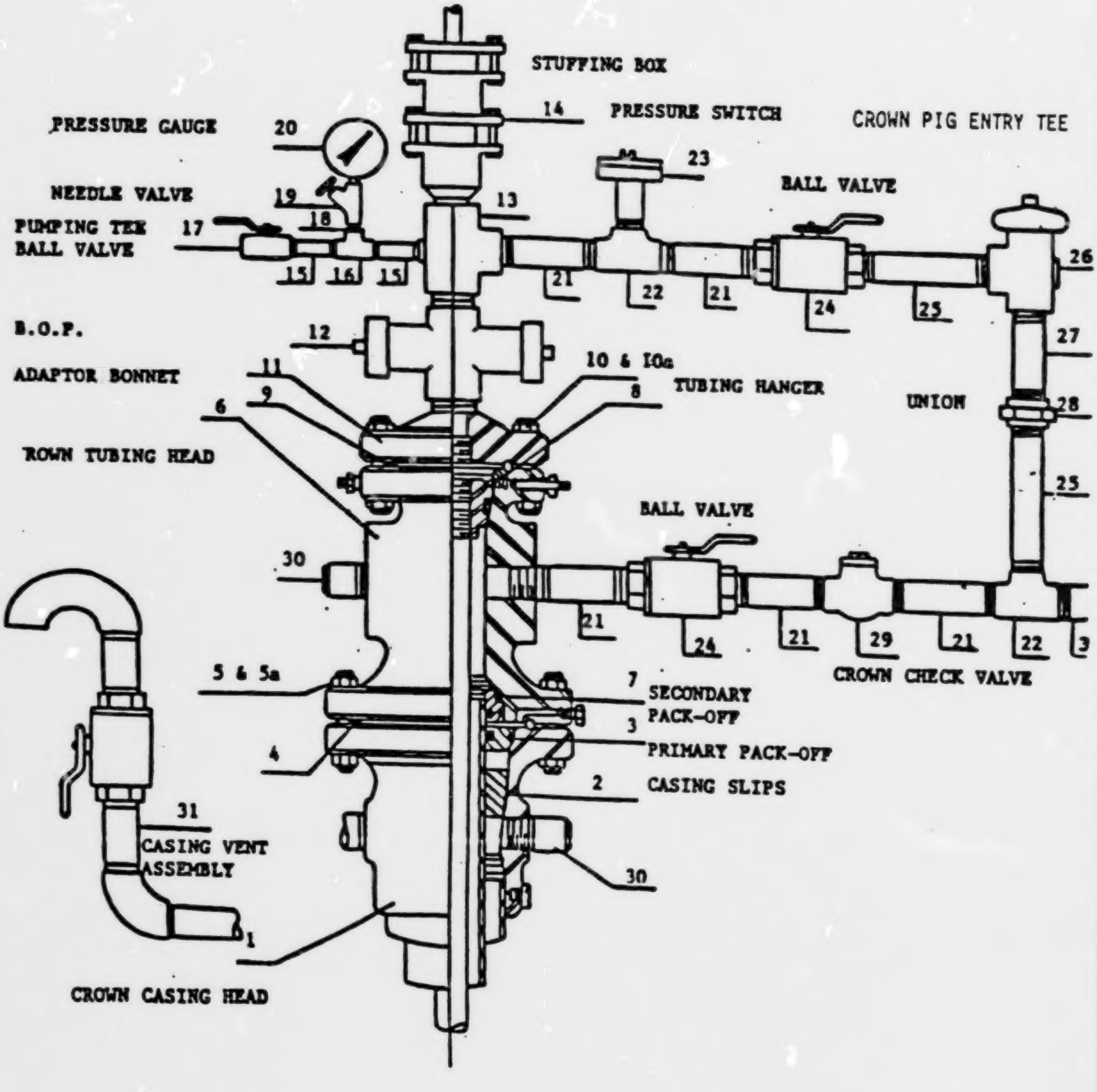
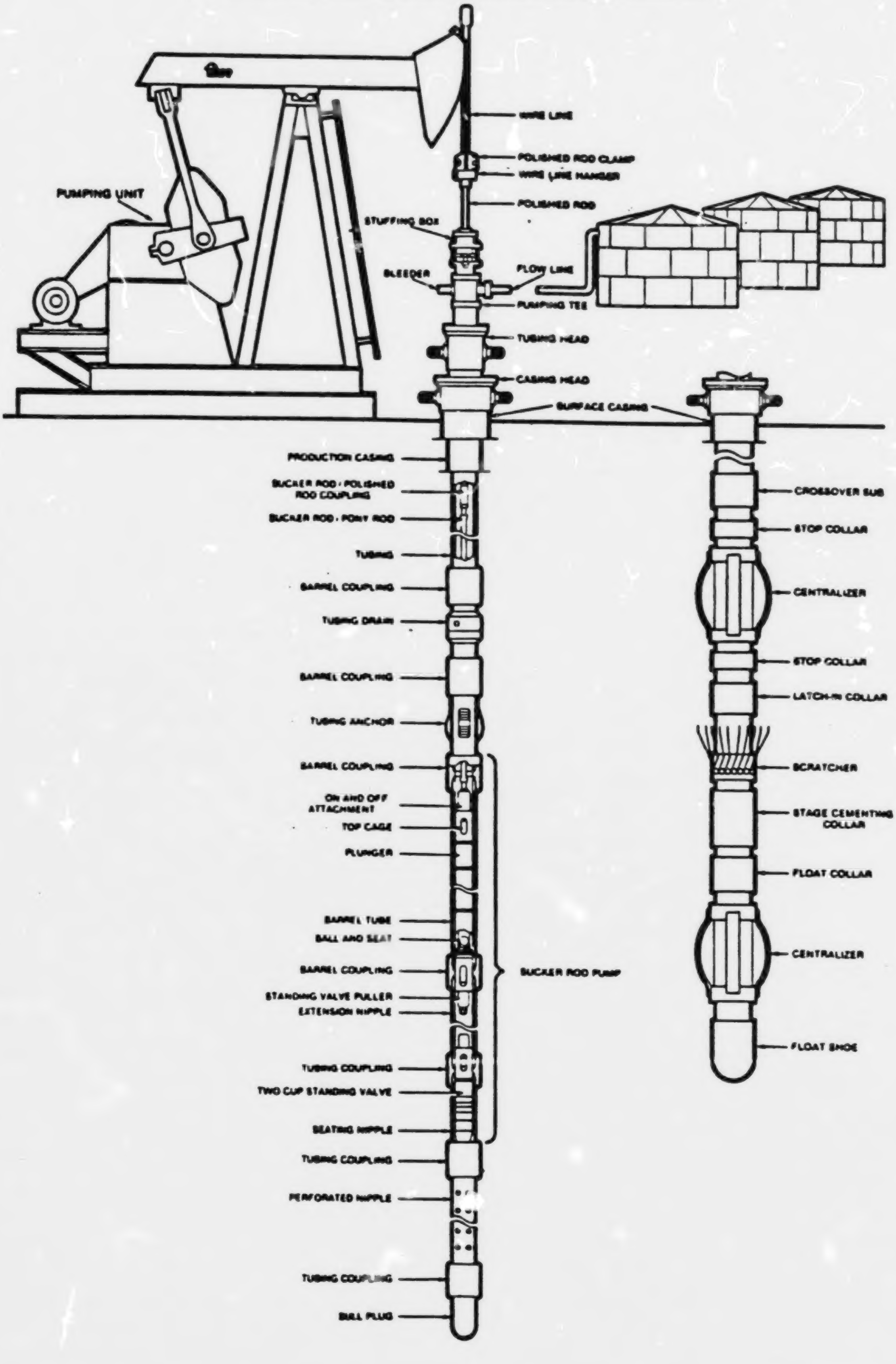

STUFFING BOX
14
PRESSURE SWITCH
CROWN PIG ENTRY TEE
PRESSURE GAUGE
20
23
NEEDLE VALVE
19
BALL VALVE
18
13
PUMPING TEE
BALL VALVE
17
15
16
15
21
22
21
24
25
26
27
B.O.P.
12
ADAPTOR BONNET
11
10 & 10a
8
TUBING HANGER
UNION
28
6
9
ROWN TUBING HEAD
25
BALL VALVE
30
21
24
21
29
21
22
3
CROWN CHECK VALVE
5 & 5a
7
SECONDARY
PACK-OFF
3
PRIMARY PACK-OFF
4
2
CASING SLIPS
31
CASING VENT
ASSEMBLY
30
1
CROWN CASING HEAD

FIGURE 4 - A TYPICAL OILWELL INSTALLATION


PUMPING UNIT
WIRE LINE
POLISHED ROD CLAMP
WIRE LINE HANGER
POLISHED ROD
STUFFING BOX
BLEEDER
FLOW LINE
PUMPING TEE
TUBING HEAD
CASING HEAD
SURFACE CASING
PRODUCTION CASING
SUCKER ROD · POLISHED ROD COUPLING
SUCKER ROD · PONY ROD
TUBING
BARREL COUPLING
TUBING DRAIN
BARREL COUPLING
TUBING ANCHOR
BARREL COUPLING
ON AND OFF ATTACHMENT
TOP CAGE
PLUNGER
BARREL TUBE
BALL AND SEAT
BARREL COUPLING
STANDING VALVE PULLER
EXTENSION NIPPLE
TUBING COUPLING
TWO CUP STANDING VALVE
SEATING NIPPLE
TUBING COUPLING
PERFORATED NIPPLE
TUBING COUPLING
BULL PLUG
SUCKER ROD PUMP
CROSSOVER SUB
STOP COLLAR
CENTRALIZER
STOP COLLAR
LATCH-IN COLLAR
SCRATCHER
STAGE CEMENTING COLLAR
FLOAT COLLAR
CENTRALIZER
FLOAT SHOE

NOTE:

Figure 5 - Rafferty Reservoir Oil Well Locations

and

Figure 6 - Alameda Reservoir Oil Well Locations

Located in Rear Cover Pocket

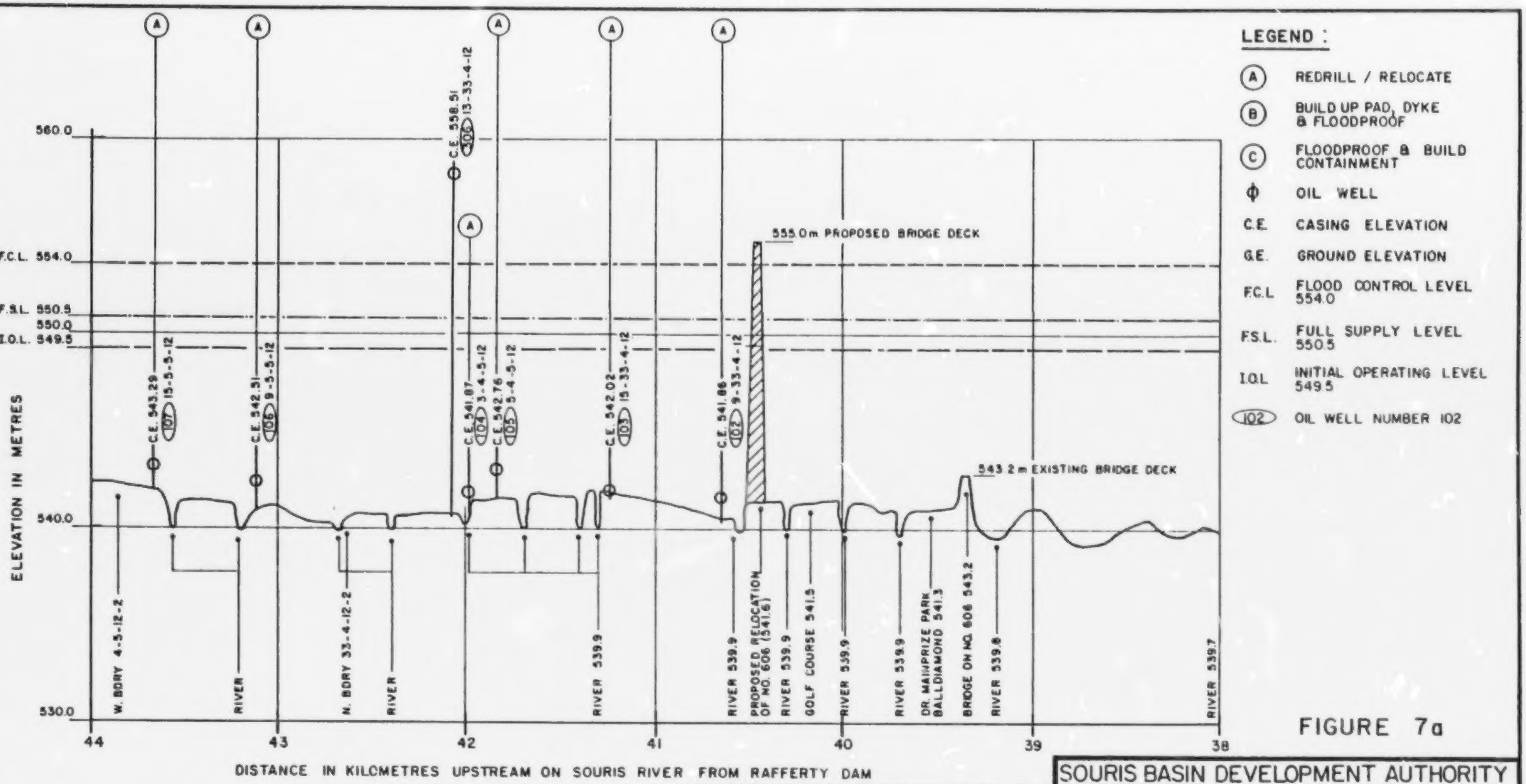


FIGURE 7a

SOURIS BASIN DEVELOPMENT AUTHORITY

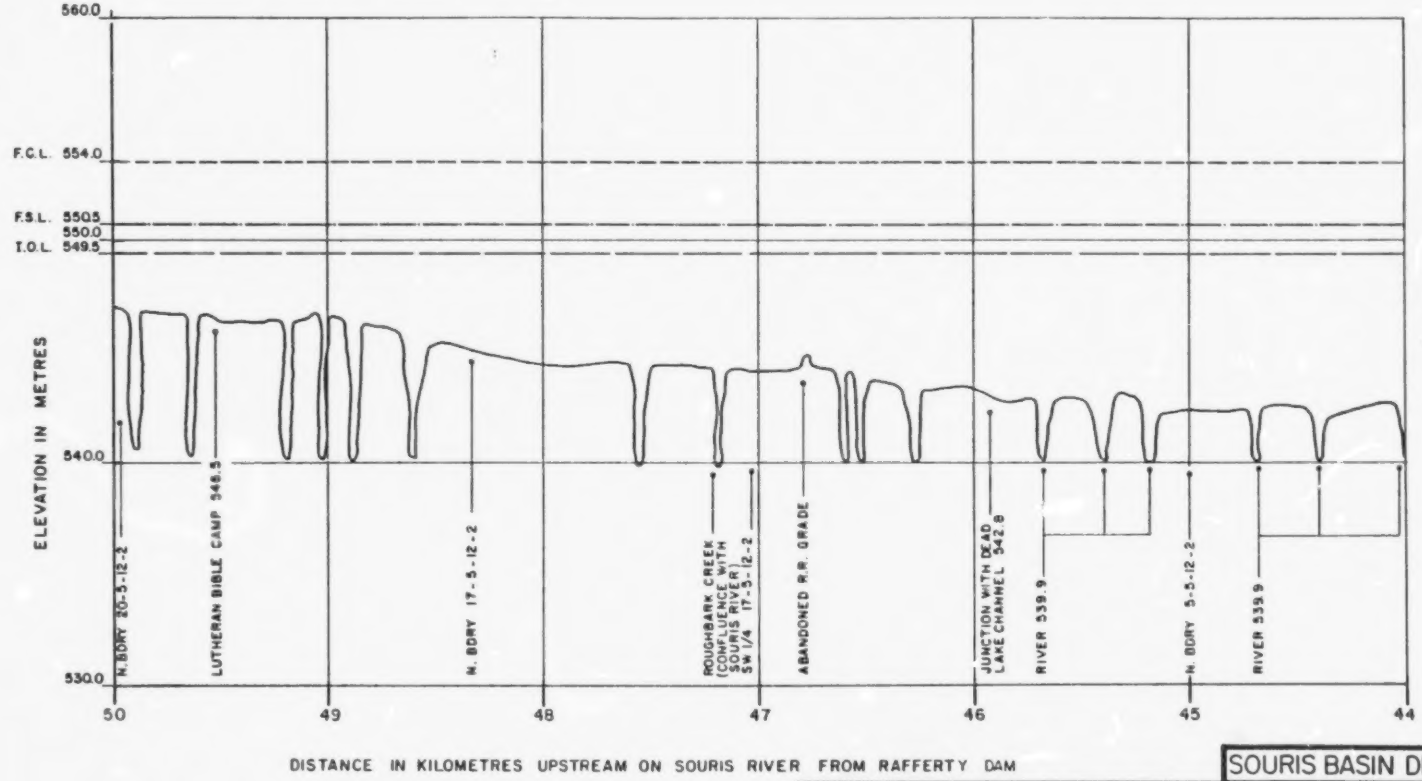
RAFFERTY / ALAMEDA PROJECTS

RAFFERTY DAM
RESERVOIR
ENVIRONMENTAL IMPACT STATEMENT
OIL WELLS
SOURIS RIVER — PROFILE

PROP	UNIT	SYST.	FUNC.	SERIAL	REV
A135	1	40	RVR	011	A

OTHER ENG. CHECKS	DRATING DEPT.
DEPT CHK'D BY DATE	DRAWN BY CHK'D BY DATE
DEPT. CHK'D BY DATE	SCALE
DEPT CHK'D BY DATE	DESIGN DIVISION DEPT DESIGNED BY CHK'D BY
DEPT CHK' BY DATE	APP'D BY DATE

DEPT.	APP'D			DEPT.	APP'D			DEPT	APP'D		
			REV.				REV.				REV.



LEGEND :

Ⓐ	REDRILL / RELOCATE
Ⓑ	BUILD UP PAD, DYKE & FLOODPROOF
Ⓒ	FLOODPROOF & BUILD CONTAINMENT
ϕ	OIL WELL
C.E.	CASING ELEVATION
G.E.	GROUND ELEVATION
F.C.L.	FLOOD CONTROL LEVEL 554.0
F.S.L.	FULL SUPPLY LEVEL 550.5
I.O.L.	INITIAL OPERATING LEVEL 549.5
(102)	OIL WELL NUMBER 102

FIGURE 7b

OTHER ENG. CHECKS	DRATING DEPT.
DEPT CHK'D BY DATE	DRAWN BY CHK'D BY DATE
DEPT. CHK'D BY DATE	SCALE
	DESIGN DIVISION
DEPT CHK'D BY DATE	DEPT DESIGNED BY CHK'D BY
DEPT CHK' BY DATE	APP'D BY DATE

DEPT	APP'D			DEPT	APP'D			DEPT	APP'D		
			REV.				REV.				REV.

SOURIS BASIN DEVELOPMENT AUTHORITY

RAFFERTY / ALAMEDA PROJECTS

RAFFERTY DAM
RESERVOIR
INVIRONMENTAL IMPACT STATEMENT
OIL WELLS
SOURIS RIVER — PROFILE

PROP	UNIT	SYST.	FUNC.	SERIAL	REV
A435	1	40	RVR	012	A

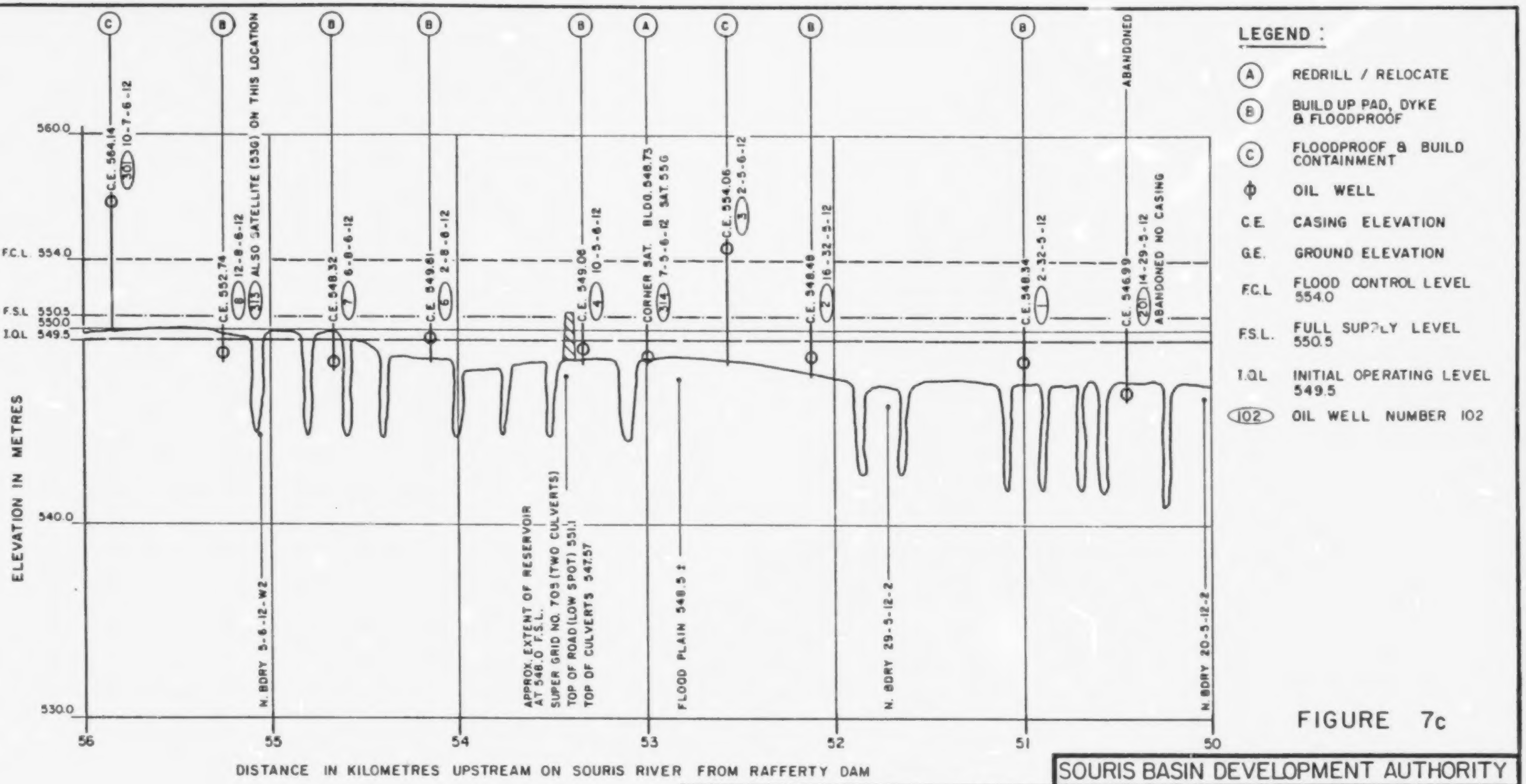


FIGURE 7c

DEPT.	APP'D			DEPT.	APP'D			DEPT.	APP'D		
			REV.				REV.				REV.

OTHER ENG. CHECKS	DRATING DEPT.
DEPT. ____ CHK'D BY ____ DATE ____	DRAWN BY ____ CHK'D BY ____ DATE ____
DEPT. ____ CHK'D BY ____ DATE ____	SCALE ____
	DESIGN DIVISION
DEPT. ____ CHK'D BY ____ DATE ____	DEPT. ____ DESIGNED BY ____ CHK'D BY ____
DEPT. ____ CHK' BY ____ DATE ____	APP'D BY ____ DATE ____

SOURIS BASIN DEVELOPMENT AUTHORITY

RAFFERTY / ALAMEDA PROJECTS

RAFFERTY DAM
RESERVOIR
ENVIRONMENTAL IMPACT STATEMENT
OIL WELLS
SOURIS RIVER — PROFILE

PROP	UNIT	SYST.	FUNC.	SERIAL	REV
A435	1	40	RVR	013	A

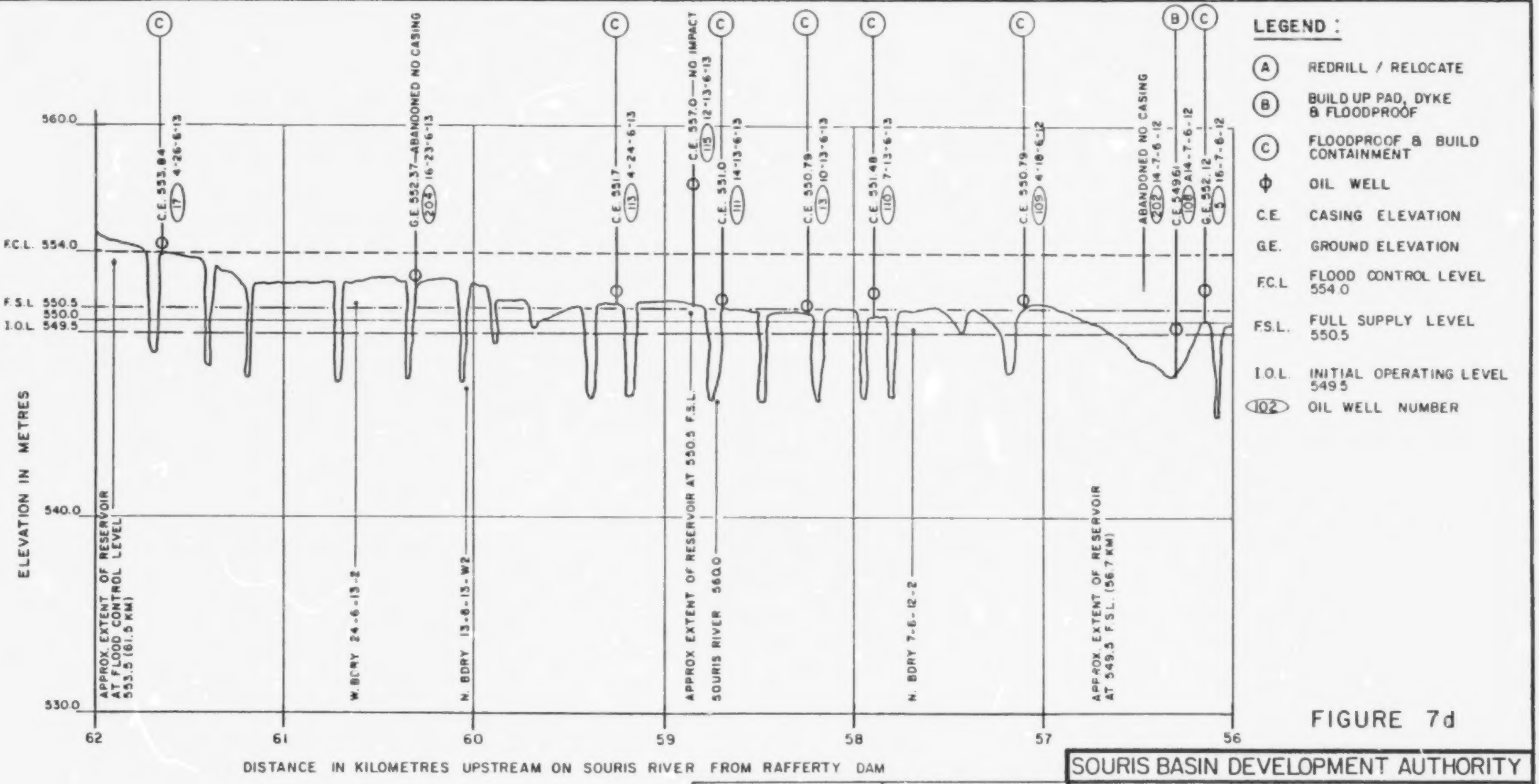

C.E. 553.84 (17) 4-26-6-13
G.E. 552.37—ABANDONED NO CASING (204) 16-23-6-13
C.E. 551.7 (113) 4-24-6-13
C.E. 557.0—NO IMPACT (115) 12-13-6-13
C.E. 551.0 (111) 14-13-6-13
C.E. 550.79 (13) 10-13-6-13
C.E. 551.48 (110) 7-13-6-13
C.E. 550.79 (109) 4-18-6-12
ABANDONED NO CASING (202) 14-7-6-12
C.E. 549.61 (108) A14-7-6-12
G.E. 552.12 (5) 16-7-6-12
A
B
C
560.0
F.C.L. 554.0
F.S.L. 550.5
550.0
I.O.L. 549.5
540.0
530.0
ELEVATION IN METRES
APPROX. EXTENT OF RESERVOIR AT FLOOD CONTROL LEVEL 553.5 (61.5 KM)
W. BDRY 24-6-13-2
N. BDRY 13-6-13-W2
APPROX EXTENT OF RESERVOIR AT 550.5 F.S.L.
SOURIS RIVER 560.0
N. BDRY 7-6-12-2
APPROX. EXTENT OF RESERVOIR AT 549.5 F.S.L. (56.7 KM)
62
61
60
59
58
57
56
DISTANCE IN KILOMETRES UPSTREAM ON SOURIS RIVER FROM RAFFERTY DAM
LEGEND :
(A) REDRILL / RELOCATE
(B) BUILD UP PAD, DYKE & FLOODPROOF
(C) FLOODPROOF & BUILD CONTAINMENT
Φ OIL WELL
C.E. CASING ELEVATION
G.E. GROUND ELEVATION
F.C.L. FLOOD CONTROL LEVEL 554.0
F.S.L. FULL SUPPLY LEVEL 550.5
I.O.L. INITIAL OPERATING LEVEL 549.5
(102) OIL WELL NUMBER

FIGURE 7d

SOURIS BASIN DEVELOPMENT AUTHORITY

RAFFERTY / ALAMEDA PROJECTS

RAFFERTY DAM
RESERVOIR
ENVIRONMENTAL IMPACT STATEMENT
OIL WELLS
SOURIS RIVER — PROFILE

PROP	UNIT	SYST.	FUNC.	SERIAL	REV
A435	1	40	RVR	014	A

OTHER ENG. CHECKS	DRATING DEPT.
DEPT. CHK'D BY DATE	DRAWN BY CHK'D BY DATE
DEPT. CHK'D BY DATE	SCALE
DEPT. CHK'D BY DATE	DESIGN DIVISION DEPT. DESIGNED BY CHK'D BY
DEPT. CHK' BY DATE	APP'D BY DATE

DEPT.	APP'D			DEPT.	APP'D			DEPT.	APP'D		
			REV				REV				REV

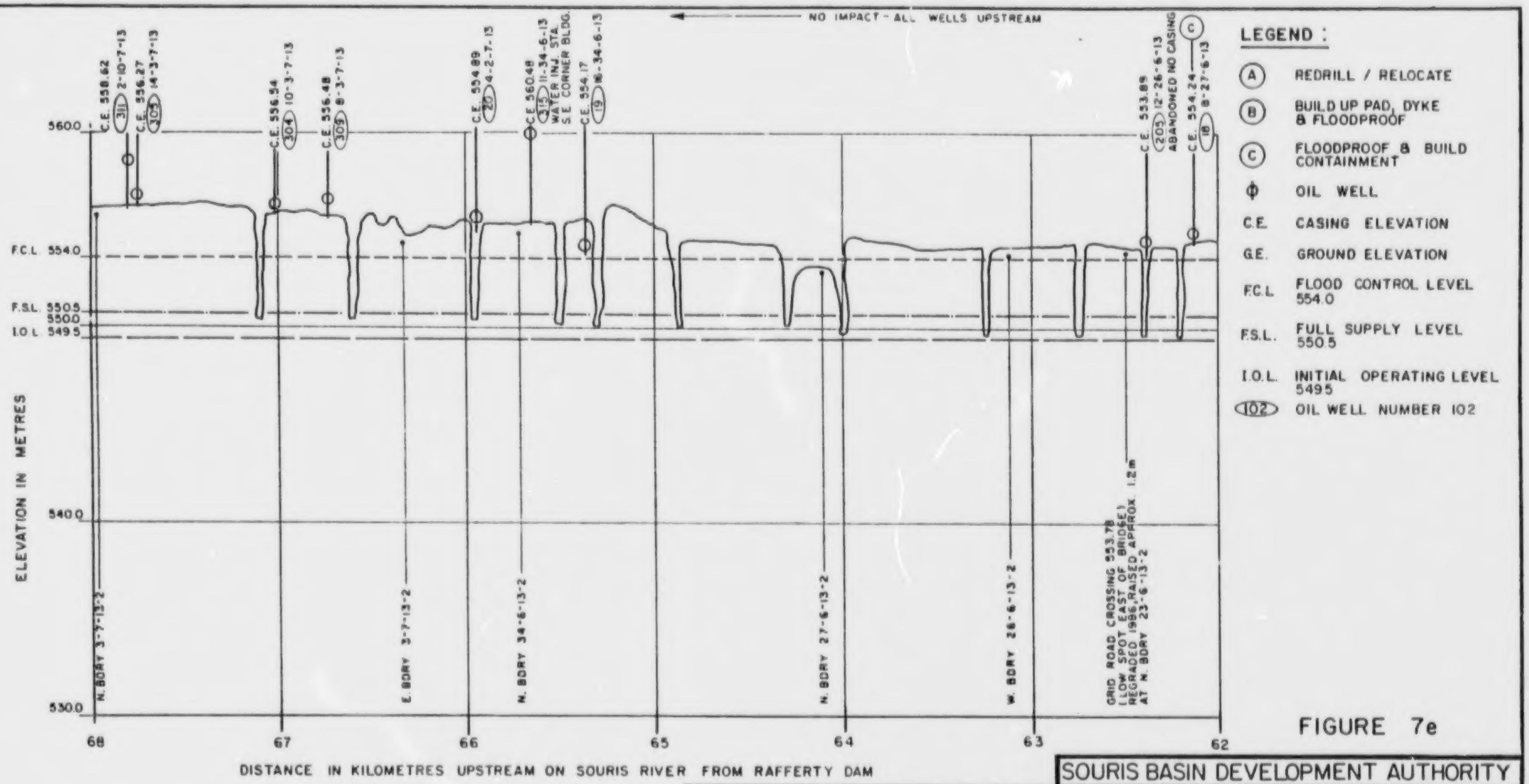


FIGURE 7e

SOURIS BASIN DEVELOPMENT AUTHORITY

RAFFERTY / ALAMEDA PROJECTS

RAFFERTY DAM
RESERVOIR
ENVIRONMENTAL IMPACT STATEMENT
OIL WELLS
SOURIS RIVER — PROFILE

PROP	UNIT	SYST.	FUNC.	SERIAL	REV
A435	1	40	RVR	015	A

DEPT.	APP'D			DEPT.	APP'D			DEPT.	APP'D		
			REV.				REV.				REV.

OTHER ENG. CHECKS
DEPT ____
CHK'D BY ____
DATE ____
DEPT. ____
CHK'D BY ____
DATE ____
DEPT ____
CHK'D BY ____
DATE ____
DEPT ____
CHK' BY ____
DATE ____

DRATING DEPT.
DRAWN BY ____
CHK'D BY ____
DATE ____
SCALE ____

DESIGN DIVISION
DEPT ____
DESIGNED BY ____
CHK'D BY ____
APP'D BY ____
DATE ____

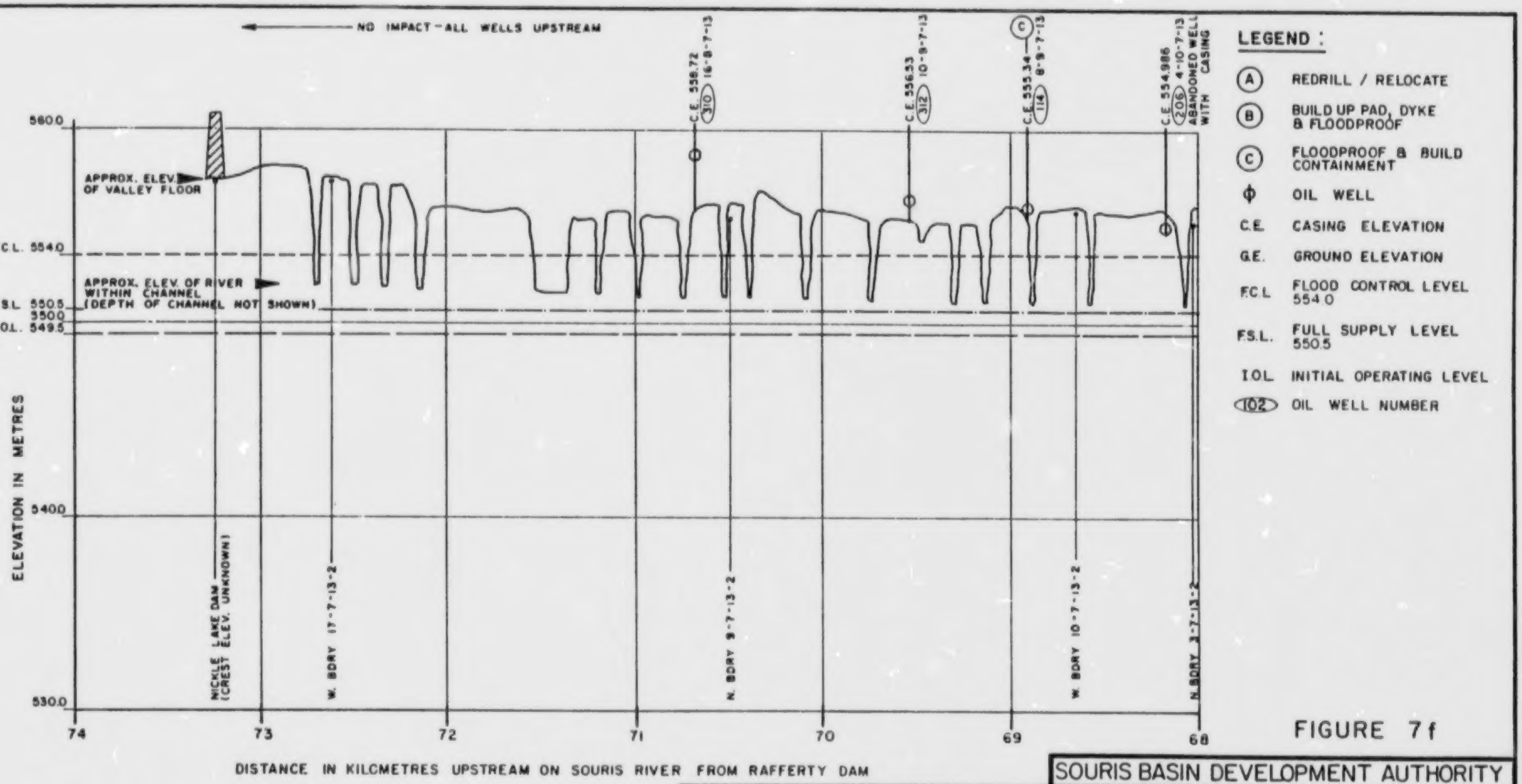


FIGURE 7f

DEPT.	APP'D			DEPT.	APP'D			DEPT	APP'D		
			REV.				REV.				REV.

OTHER ENG. CHECKS	DRATING DEPT.
DEPT. CHK'D BY DATE	DRAWN BY CHK'D BY DATE
DEPT. CHK'D BY DATE	SCALE
	DESIGN DIVISION
DEPT. CHK'D BY DATE	DEPT. DESIGNED BY CHK'D BY
DEPT. CHK' BY DATE	APP'D BY DATE

SOURIS BASIN DEVELOPMENT AUTHORITY

RAFFERTY / ALAMEDA PROJECTS

RAFFERTY DAM
RESERVOIR
ENVIRONMENTAL IMPACT STATEMENT
OIL WELLS
SOURIS RIVER — PROFILE

PROP	UNIT	SYST.	FUNC.	SERIAL	REV
A435	1	40	RVR	016	A

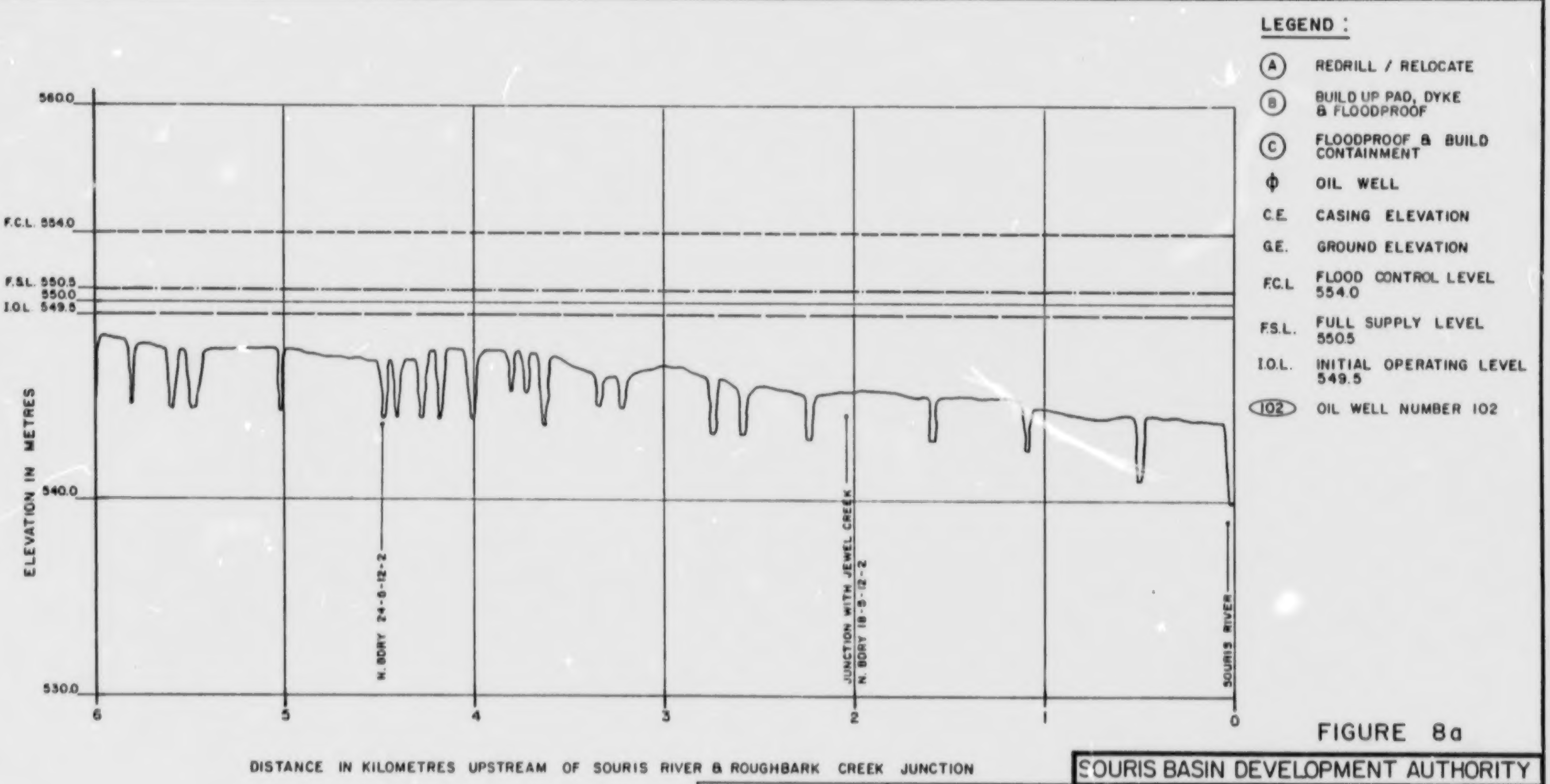


FIGURE 8a

DEPT.	APP'D			DEPT.	APP'D			DEPT	APP'D		
			REV.				REV.				REV.

OTHER ENG. CHECKS
DEPT ____
CHK'D BY ____
DATE ____
DEPT. ____
CHK'D BY ____
DATE ____
DEPT ____
CHK'D BY ____
DATE ____
DEPT ____
CHK' BY ____
DATE ____

DRATING DEPT.
DRAWN BY ____
CHK'D BY ____
DATE ____
SCALE ____

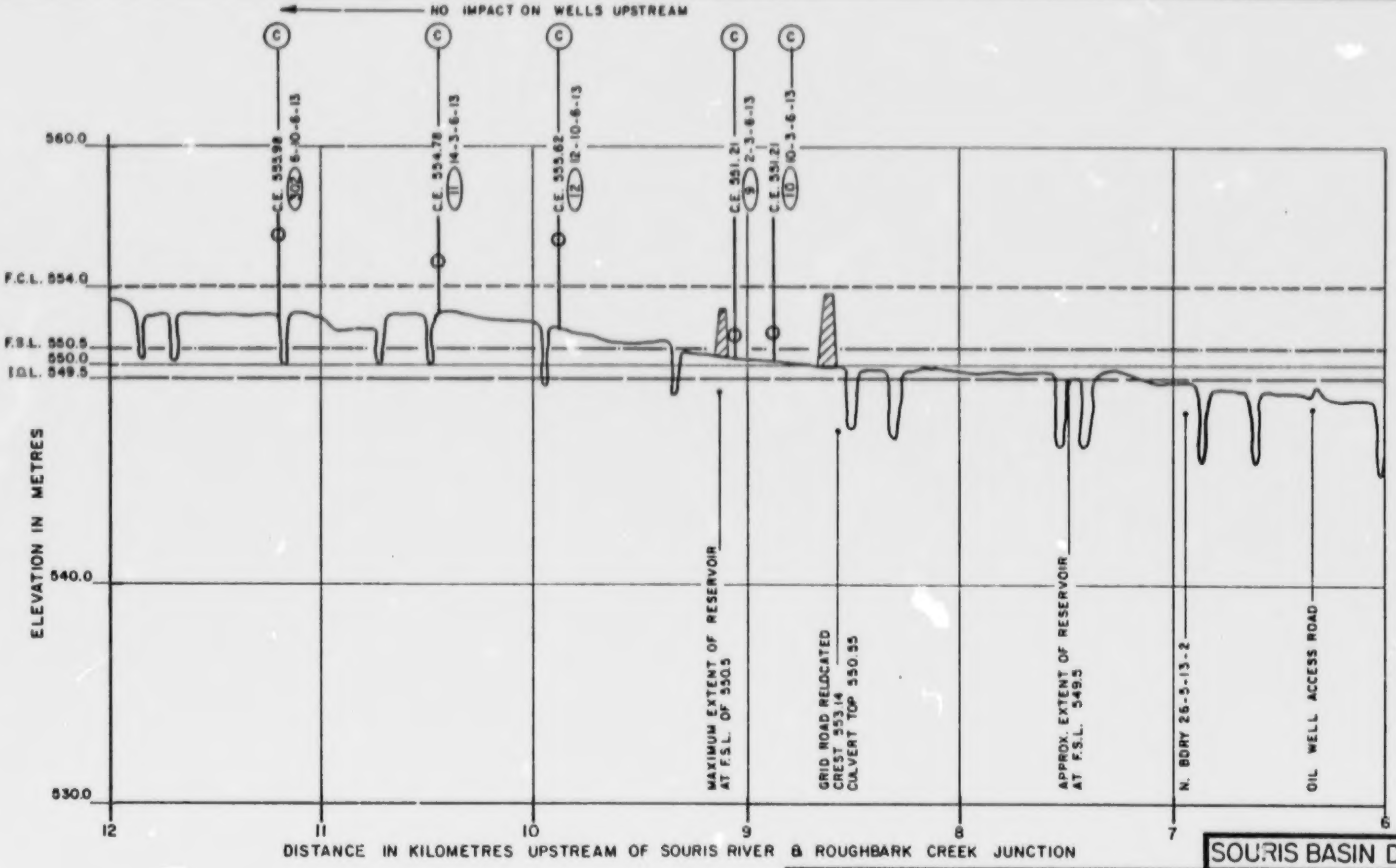
DESIGN DIVISION
DEPT ____
DESIGNED BY ____
CHK'D BY ____
APP'D BY ____
DATE ____

SOURIS BASIN DEVELOPMENT AUTHORITY

RAFFERTY / ALAMEDA PROJECTS

RAFFERTY DAM
RESERVOIR
ENVIRONMENTAL IMPACT STATEMENT
OIL WELLS
ROUGHBARK CREEK – PROFILE

PROP	UNIT	SYST.	FUNC.	SERIAL	REV
A435	1	40	RVR	017	A



LEGEND :

Ⓐ	REDRILL / RELOCATE
Ⓑ	BUILD UP PAD, DYKE & FLOODPROOF
Ⓒ	FLOODPROOF & BUILD CONTAINMENT
ɸ	OIL WELL
C.E.	CASING ELEVATION
G.E.	GROUND ELEVATION
F.C.L.	FLOOD CONTROL LEVEL 554.0
F.S.L.	FULL SUPPLY LEVEL 550.5
I.O.L.	INITIAL OPERATING LEVEL 549.5
(102)	OIL WELL NUMBER 102

FIGURE 8b

DEPT.	APP'D			DEPT.	APP'D			DEPT	APP'D		
			REV.				REV.				REV.

OTHER ENG. CHECKS	DRATING DEPT.
DEPT CHK'D BY DATE	DRAWN BY CHK'D BY DATE
DEPT. CHK'D BY DATE	SCALE
	DESIGN DIVISION
DEPT CHK'D BY DATE	DEPT DESIGNED BY CHK'D BY
DEPT CHK' BY DATE	APP'D BY DATE

SOURIS BASIN DEVELOPMENT AUTHORITY

RAFFERTY / ALAMEDA PROJECTS

RAFFERTY DAM
RESERVOIR
ENVIRNMENTAL IMPACT STATEMENT
OIL WELLS
ROUGHBARK CREEK – PROFILE

PROP	UNIT	SYST.	FUNC.	SERIAL	REV
A435	1	40	RVR	018	A

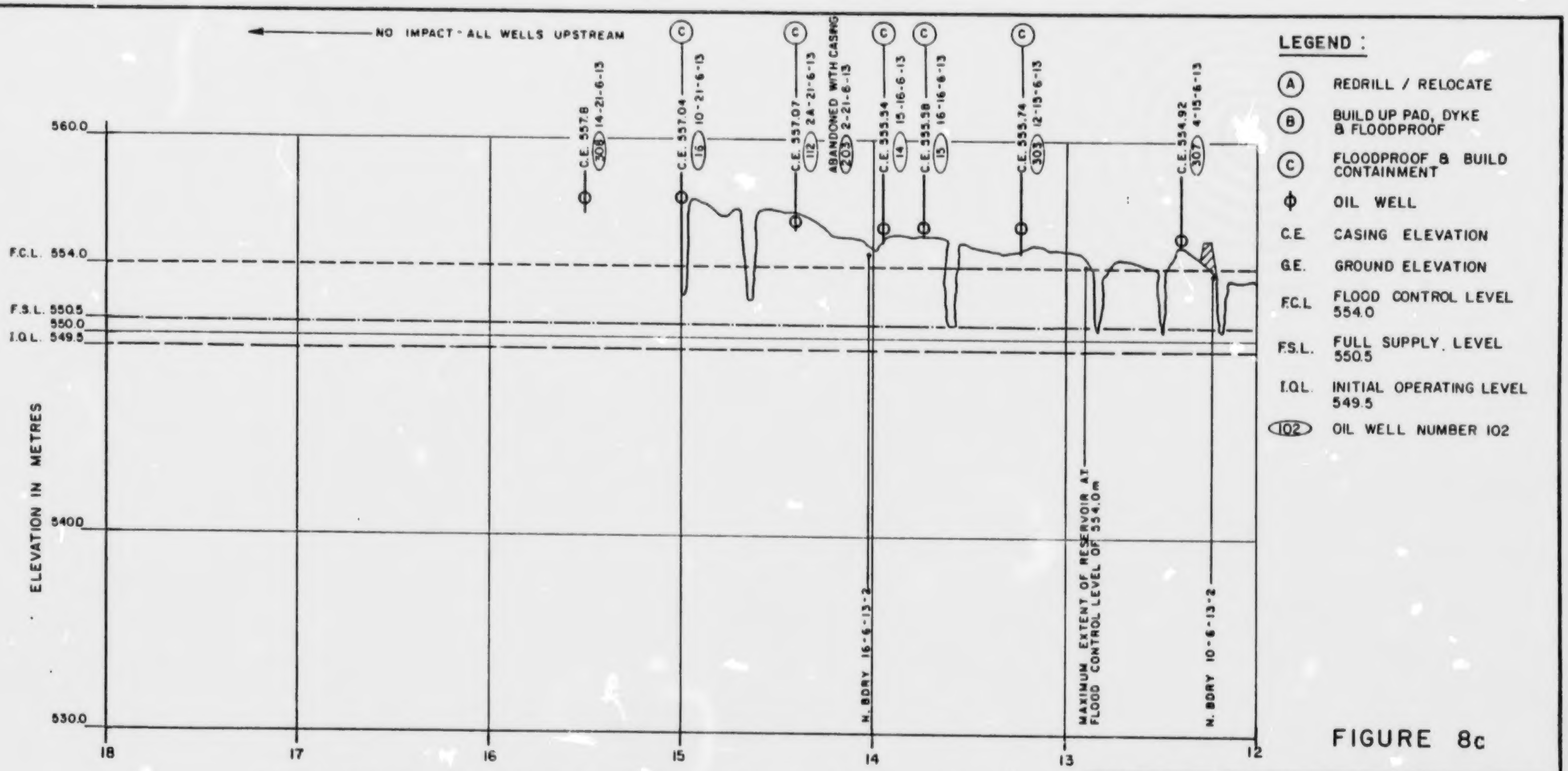


FIGURE 8c

SOURIS BASIN DEVELOPMENT AUTHORITY

RAFFERTY / ALAMEDA PROJECTS

RAFFERTY DAM
RESERVOIR
ENVIRNMENTAL IMPACT STATEMENT
OIL WELLS
ROUGHBARK CREEK– PROFILE

PROP	UNIT	SYST.	FUNC.	SERIAL	REV
A435	1	40	RVR	019	A

OTHER ENG. CHECKS
DEPT
CHK'D BY
DATE
DEPT.
CHK'D BY
DATE
DEPT
CHK'D BY
DATE
DEPT
CHK' BY
DATE

DRATING DEPT.
DRAWN BY
CHK'D BY
DATE
SCALE

DESIGN DIVISION
DEPT
DESIGNED BY
CHK'D BY
APP'D BY
DATE

DEPT.	APP'D			DEPT.	APP'D			DEPT	APP'D		
			REV.				REV.				REV.

COST OF OILFIELD MITIGATION PROCEDURES ON A WELL BY WELL BASIS

FILE NUMBER	WELL LOCATION	ELEVATION (METRES)	MITIGATION CODE NEW	MITIGATION CODE OLD	STATUS	ACCESS ROAD ELEVATION (LOW SPOT) (METRES)	RELOCATE & DIRECTIONALLY DRILL	CONSTRUCT FLOOD DYKE	RIP RAP	ELEVATE WELL HEAD & PUMP PAD	ELEVATE LEASE ACCESS ROAD	ABANDON FACILITY	FLOOD PROOF FACILITY	CONSTRUCT CONTAINMENT DYKE	ESTIMATED RANGE OF COSTS (PER ,000)
1	2-32-5-12 W2M	C.E. 548.34	B	3	Oilwell	546.5		X	X	X	X		X		151.1 to 265.8
2	16-32-5-12 W2M	C.E. 547.98	B	3	Press Maintenance	551.59		X	X	NO X PUMP	X		X		158.76 to 262.5
3	2-5-6-12 W2M	C.E. 554.06	C	1	Oilwell	549.82					X			X	4.5 to 80.3
4	10-5-6-12 W2M	C.E. 549.06	B	3	Oilwell	547.99		X	X	X	X		X		67.89 to 123.6
5	16-7-6-12 W2M	G.E. 552.12	C	3	Pressure Maint.	548.45				X	X		X	X	14.0 to 150.7
6	2-8-6-12 W2M	C.E. 549.61	B	3	Oilwell	551.91		X	X	X			X		141.1 to 270.2
7	6-8-6-12 W2M	C.E. 548.32	B	3	Press Maint.	548.80		X	X	X	X		X		163.9 to 274.6
8	12-8-6-12 W2M	C.E. 548.78	B	3	Oilwell	548.30		X	X	X			X	X	105.5 to 205.3
9	2-3-6-13 W2M	C.E. 551.21	C	1	"	562.94							X	X	7.2 to 110.0
10	10-3-6-13 W2M	C.E. 551.28	C	3	"	551.23							X	X	7.2 to 118.8
11	14-3-6-13 W2M	C.E. 554.78	C	1	"	557.51								X	4.5 to 45.1
12	12-10-6-13 W2M	C.E. 555.62	C	1	"	555.75								X	4.5 to 129.8
13	10-13-6-13 W2M	C.E. 550.79	C	3	"	550.79							X	X	11.7 to 77.0
14	15-16-6-13 W2M	C.E. 555.54	C	1	WSW	557.51								X	4.5 to 95.7
15	16-16-6-13 W2M	C.E. 555.58	C	1	Press Maint.	555.70								X	4.5 to 81.4
16	10-21-6-13 W2M	C.E. 557.04	C	1	Oilwell	556.95								X	4.5 to 100.1
17	4-26-6-13 W2M	C.E. 553.84	C	1	"	553.64								X	6.3 to 103.4
18	8-27-6-13 W2M	C.E. 554.24	C	1	"	553.49								X	4.5 to 56.1
19	16-34-6-13 W2M	G.E. 554.17	C	1	Press Maint.	554.69								X	9.0 to 311.3
20	4-2-7-13 W2M	C.E. 554.89	C	1	Oilwell	554.72								X	4.5 to 100.1

FLOOD CONTROL LEVEL (F.C.L.) 554.0 METRES ABOVE SEA LEVEL

FULL SUPPLY LEVEL (F.S.L.) 550.5 METRES ABOVE SEA LEVEL

INITIAL OPERATING LEVEL (I.O.L.) 549.5 METRES ABOVE SEA LEVEL

OLD MITIGATION CODE

1 - Construct Dyke Around Well-Site
2 - Construct Elevated Pad, Raise Wellhead and Dyke
3 - Abandon Well and Directionally Drill a New Well from A Location Above 553.5 metres A.S.L.

C.E. - Casing Elevation
G.E. - Ground Elevation

NEW MITIGATION CODE

A - Abandon And Directionally Drill a New Well From an Elevation Above 548.5 Metres Above Sea Level.
B - Construct Elevated Pad, Raise Wellhead, Dyke and Flood Proof If necessary.
C - Flood Proof and Construct Containment Dyke

FIGURE 9a

COST OF OILFIELD MITIGATION PROCEDURES ON A WELL BY WELL BASIS

FILE NUMBER	WELL LOCATION	ELEVATION (METRES)	MITIGATION CODE NEW	MITIGATION CODE OLD	STATUS	ACCESS ROAD ELEVATION (LOW SPOT)	RELOCATE & DIRECTIONALLY DRILL	CONSTRUCT FLOOD DYKE	RIP RAP	ELEVATE WELL HEAD & PUMP PAD	ELEVATE LEASE ACCESS ROAD	ABANDON FACILITY	FLOOD PROOF FACILITY	CONSTRUCT CONTAINMENT DYKE	ESTIMATED RANGE OF COSTS (PER ,000)
101	9-35-3-11 W2M	C.E. 539.27	A	3	Oilwell	538.19	X					X			262.8 to 321.2
102	9-33-4-12 W2M	C.E. 541.86	A	3	"	541.24	X					X			467.25 to 525.0
103	15-33-4-12 W2M	C.E. 542.02	A	3	"	541.15	X					X			" "
104	3-4-5-12 W2M	C.E. 541.87	A	3	"	542.05	X					X			" "
105	5-4-5-12 W2M	C.E. 542.76	A	3	"	542.12	X					X			" "
106	9-5-5-12 W2M	C.E. 542.51	A	3	"	541.41	X					X			" "
107	15-5-5-12 W2M	C.E. 543.29	A	3	"	542.58	X					X			" "
108	A14-7-6-12 W2M	C.E. 549.61	B	3	"	550.85		X	X	X	X		X		91.6 to 111.5
109	4-18-6-12 W2M	C.E. 550.79	C	3	"	550.41							X	X	7.2 to 8.8
110	7-13-6-13 W2M	C.E. 551.48	C	3	"	551.32							X	X	" "
111	14-13-6-13 W2M	C.E. 551.00	C	3	"	550.20							X	X	" "
112	2A-21-6-13 W2M	C.E. 557.07	above FCL	3	"	556.22								X	4.5 to 5.5
113	4-24-6-13 W2M	C.E. 551.7	C	3	"	551.75							X	X	7.2 to 8.8
114	8-9-7-13 W2M	C.E. 555.34	above FCL	1	"	555.71								X	4.5 to 5.5
115	12-13-6-13 W2M	C.E. 557.0	above FCL	--	Battery & Oilwell	555.93								X?	4.5 to 5.5

FLOOD CONTROL LEVEL (F.C.L.) 554.0 METRES ABOVE SEA LEVEL

FULL SUPPLY LEVEL(F.S.L.) 550.5 METRES ABOVE SEA LEVEL

INITIAL OPERATING LEVEL (I.O.L.) 549.5 METRES ABOVE SEA LEVEL

OLD MITIGATION CODE

1 - Construct Dyke Around Well - Site
2 - Construct Elevated Pad, Raise Wellhead and Dyke
3 - Abandon Well and Directionally Drill a New Well from A Location Above 553.5 metres Above Sea Level

NEW MITIGATION CODE

A - Abandon and Directionally Drill a New Well From an Elevation Above 548.5 Metres Above Sea Level
B - Construct Elevated Pad, Raise Wellhead, Dyke and Flood Proof if Necessary
C - Flood Proof and Construct Containment Dyke

FIGURE 9b

COST OF OILFIELD MITIGATION PROCEDURES ON A WELL BY WELL BASIS

FILE NUMBER	WELL LOCATION	ELEVATION (METRES)	MITIGATION CODE		STATUS	ACCESS ROAD ELEVATION (LOW SPOT)	RELOCATE & DIRECTIONALLY DRILL	CONSTRUCT FLOOD DYKE	RIP RAP	ELEVATE WELL HEAD & PUMP PAD	ELEVATE LEASE ACCESS ROAD	ABANDON FACILITY	FLOOD PROOF FACILITY	CONSTRUCT CONTAINMENT DYKE	ESTIMATED RANGE OF COSTS (PER ,000)
			NEW	OLD											
ABANDONED WELLS															
201	14-29-5-12 W2M	G.E. 546.99			No casing Abandoned										
202	14-7-6-12 W2M	G.E. 549.50			"	(See 108 A14-7-6-12 W2M)									
203	2-21-6-13 W2M	G.E. 556.26	Above FCL	No Action	casing	(See 112 2A -21-6-13 W2M)									
204	16-23-6-13 W2M	G.E. 552.37			"										
205	12-26-6-13 W2M	G.E. 553.89	Above FCL	No Action	casing "										
206	4-10-7-13 W2M	G.E. 554.96	Above FCL	No Action	"										

FLOOD CONTROL LEVEL (F.C.L.) 554.0 METRES ABOVE SEA LEVEL

FULL SUPPLY LEVEL (F.S.L.) 550.5 METRES ABOVE SEA LEVEL

INITIAL OPERATING LEVEL (I.O.L.) 549.5 METRES ABOVE SEA LEVEL

OLD MITIGATION CODE

1 - Construct Dyke Around Well-Site
2 - Construct Elevated Pad, Raise Wellhead and Dyke
3 - Abandon Well and Directionally Drill a New Well from A Location Above 553.5 Metres Above Sea Level

NEW MITIGATION CODE

A - Abandon and Directionally Drill a New Well From an Elevation Above 548.5 Metres Above Sea Level
B - Construct Elevated Pad, Raise Wellhead, Dyke and Flood Proof
C - Flood Proof and Construct Containment Dyke

FIGURE 9c

COST OF OILFIELD MITIGATION PROCEDURES ON A WELL BY WELL BASIS

FILE NUMBER	WELL LOCATION	ELEVATION (METRES)	MITIGATION CODE NEW	MITIGATION CODE OLD	STATUS	ACCESS ROAD ELEVATION (LOW SPOT)	RELOCATE & DIRECTIONALLY DRILL	CONSTRUCT FLOOD DYKE	RIP RAP	ELEVATE WELL HEAD & PUMP PAD	ELEVATE LEASE ACCESS ROAD	ABANDON FACILITY	FLOOD PROOF FACILITY	CONSTRUCT CONTAINMENT DYKE	ESTIMATED RANGE OF COSTS (PER ,000)
301	10-7-6-12 W2M	C.E. 556.14	C		Oilwell	559.09								X	4.5 to 5.5
302	6-10-6-13 W2M	C.E. 555.98	C		"	553.34								X	4.5 to 5.5
303	12-15-6-13 W2M	G.E. 555.74	C		"	558.10								X	4.5 to 5.5
304	10-3-7-13- W2M	C.E. 556.54	Above FCL		"	555.95									
305	14-3-7-13 W2M	C.E. 556.27	"		"	556.80									
306	13-33-4-12 W2M	C.E. 558.7	"		"	558.04									
307	4-15-6-13 W2M	C.E. 554.92	"		"	554.54									
308	14-21-6-13 W2M	C.E. 557.8	"		"	558.05									
309	8-3-7-13 W2M	C.E. 556.48	"		"	556.48									
310	16-8-7-13 W2M	C.E. 558.72	"		"	560.67									
311	2-10-7-13 W2M	C.E. 556.62	"		"	558.91									
312	10-9-7-13 W2M	C.E. 556.53	"		"	558.69									
313	12-8-6-12 W2M	C.E. 552.74			Oilwell Satellite 536	550.32									
314	7-5-6-12 W2M	BW 548.73			Satellite	548.29	(Relocate)					X			585.0 to 715.
315	11-34-6-13 W2M	BW 560.43	Above FCL			558.69									
															4,093 to 8,720

FLOOD CONTROL LEVEL (F.C.L.) 554.0 METRES ABOVE SEA LEVEL

FULL SUPPLY LEVEL (F.S.L.) 550.5 METRES ABOVE SEA LEVEL

INITIAL OPERATING LEVEL (I.O.L.) 549.5 METRES ABOVE SEA LEVEL

OLD MITIGATION CODE

1 - Construct Dyke Around Well-Site
2 - Construct Elevated Pad, Raise Wellhead and Dyke
3 - Abandon Well and Directionally Drill a New Well from A Location Above 553.5 Metres Above Sea Level

NEW MITIGATION CODE

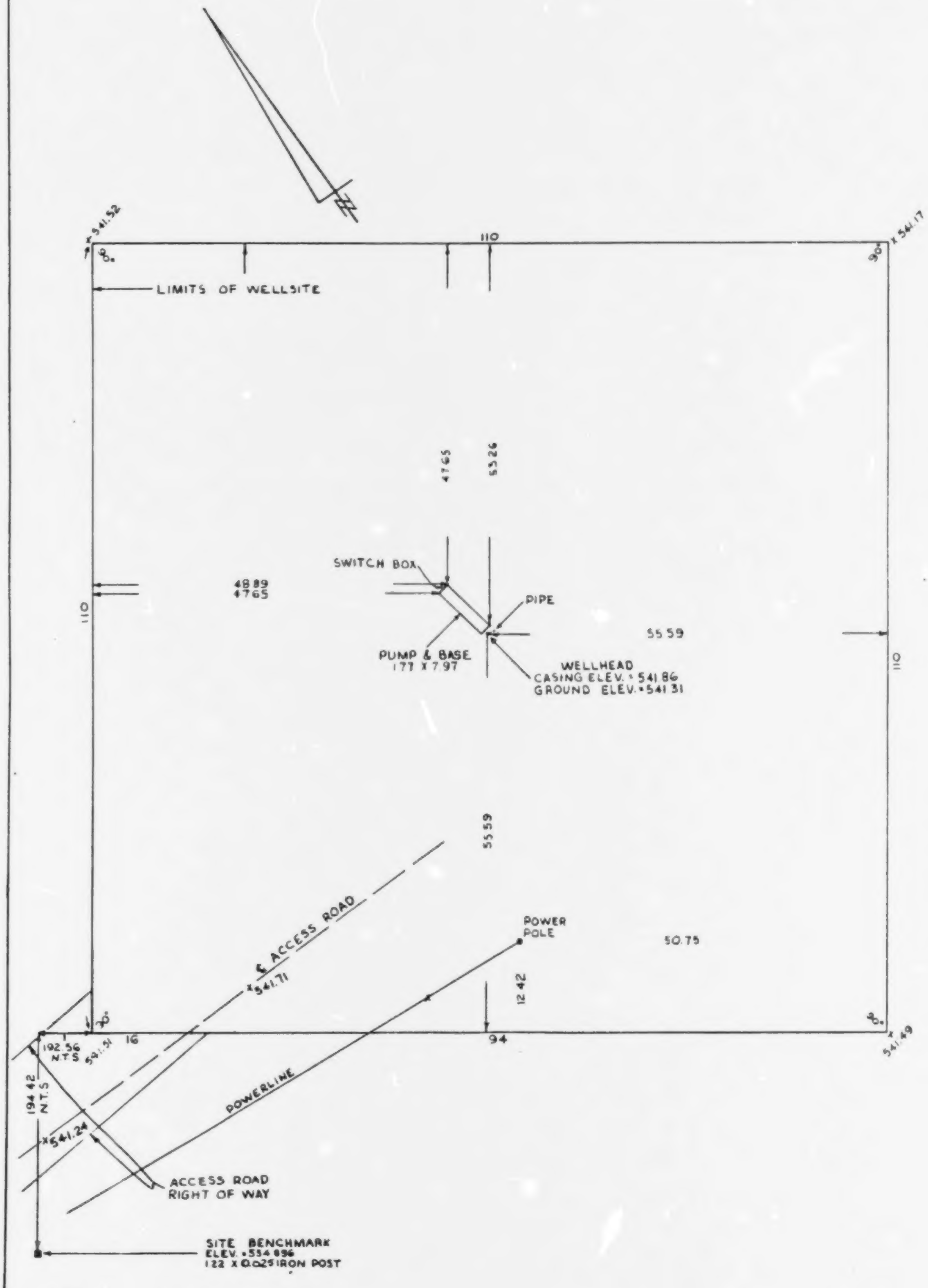
A - Abandon and Directionally Drill a New Well From and Elevation Above 548.5 Metres Above Sea
B - Construct Elevated Pad, Raise Wellhead, Dyke and Flood Proof
C - Flood Proof and Construct Containment Dyke

FIGURE 9d

FIGURE 10

OIL FACILITY VERIFICATION SURVEY PLATS

(RAFFERTY AREA)

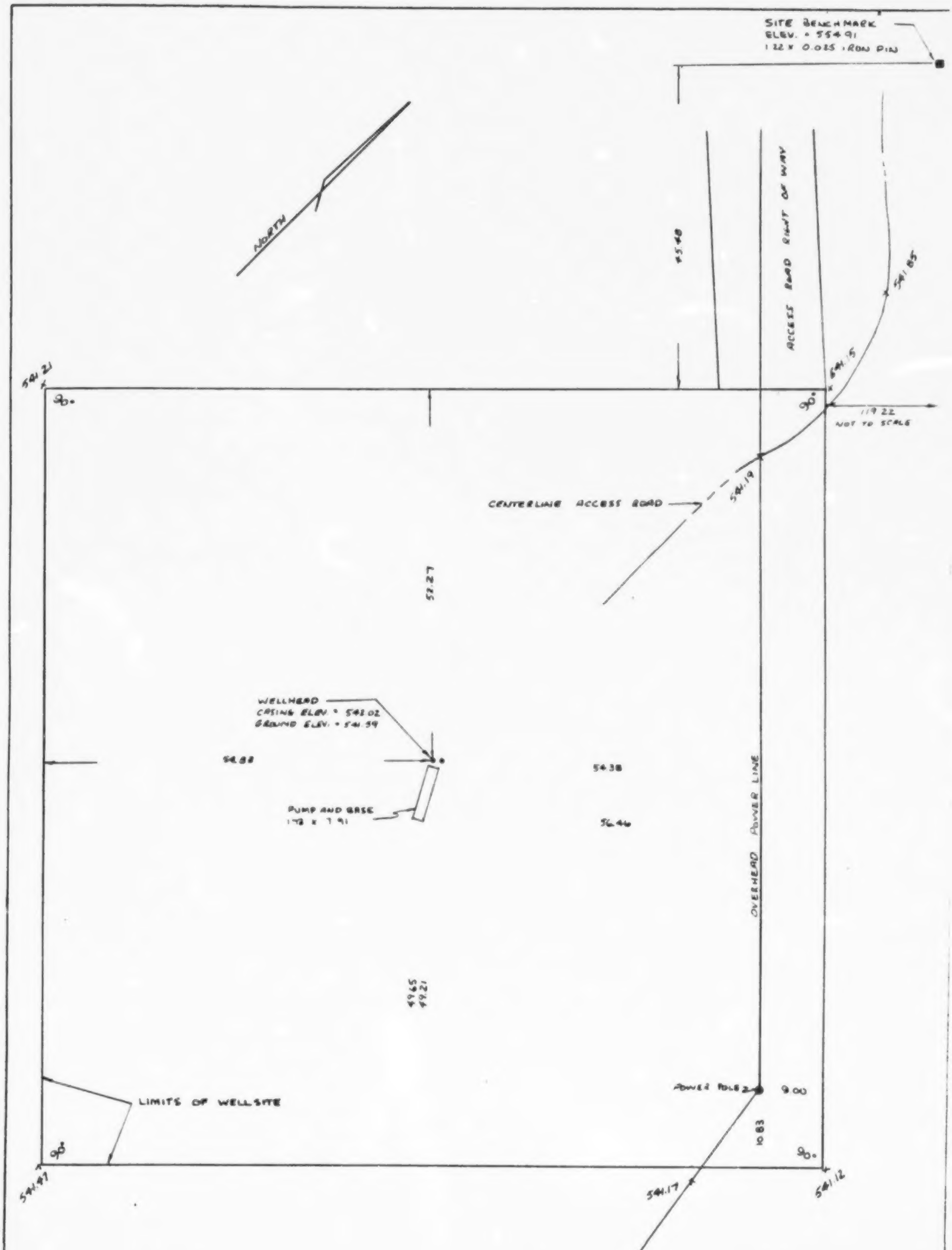

x 541.52
90°
110
x 541.17
90°
LIMITS OF WELLSITE
47.65
53.26
SWITCH BOX
48.89
47.65
PIPE
110
55.59
110
PUMP & BASE
1.77 X 7.97
WELLHEAD
CASING ELEV. = 541.86
GROUND ELEV. = 541.31
55.59
℄ ACCESS ROAD
x 541.71
POWER POLE
50.75
12.42
90°
90°
16
94
x 541.49
192.56 N.T.S.
541.51
194.42 N.T.S.
POWERLINE
x 541.24
ACCESS ROAD RIGHT OF WAY
SITE BENCHMARK
ELEV. = 534.896
1.22 X 0.025 IRON POST

NOTE

DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS . . . . . . ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE SURVEYS LTD. REGINA, MOOSE JAW	SKETCH PLAN SHOWING WELLSITE ROXY ET AL N. ELSWICK 9-33-4-12 LSD 9 - SEC 33 - TWP 4 - RGE 12 - W2M	SCALE: 1:500 DATE: DEC. 1, 1986 DRAWN BY: G.A.R. DRAWING NO.: 2500-1


SITE BENCHMARK
ELEV. = 554.91
1.22 × 0.025 IRON PIN
NORTH
45.40
ACCESS ROAD RIGHT OF WAY
541.85
541.21
90°
541.5
90°
119.22
NOT TO SCALE
CENTERLINE ACCESS ROAD
541.19
53.27
WELLHEAD
CASING ELEV. = 542.02
GROUND ELEV. = 541.59
54.88
54.38
PUMP AND BASE
1.78 × 7.91
56.46
OVERHEAD POWER LINE
49.65
49.21
POWER POLE 2
9.00
LIMITS OF WELLSITE
10.83
90°
90°
541.47
541.17
541.12

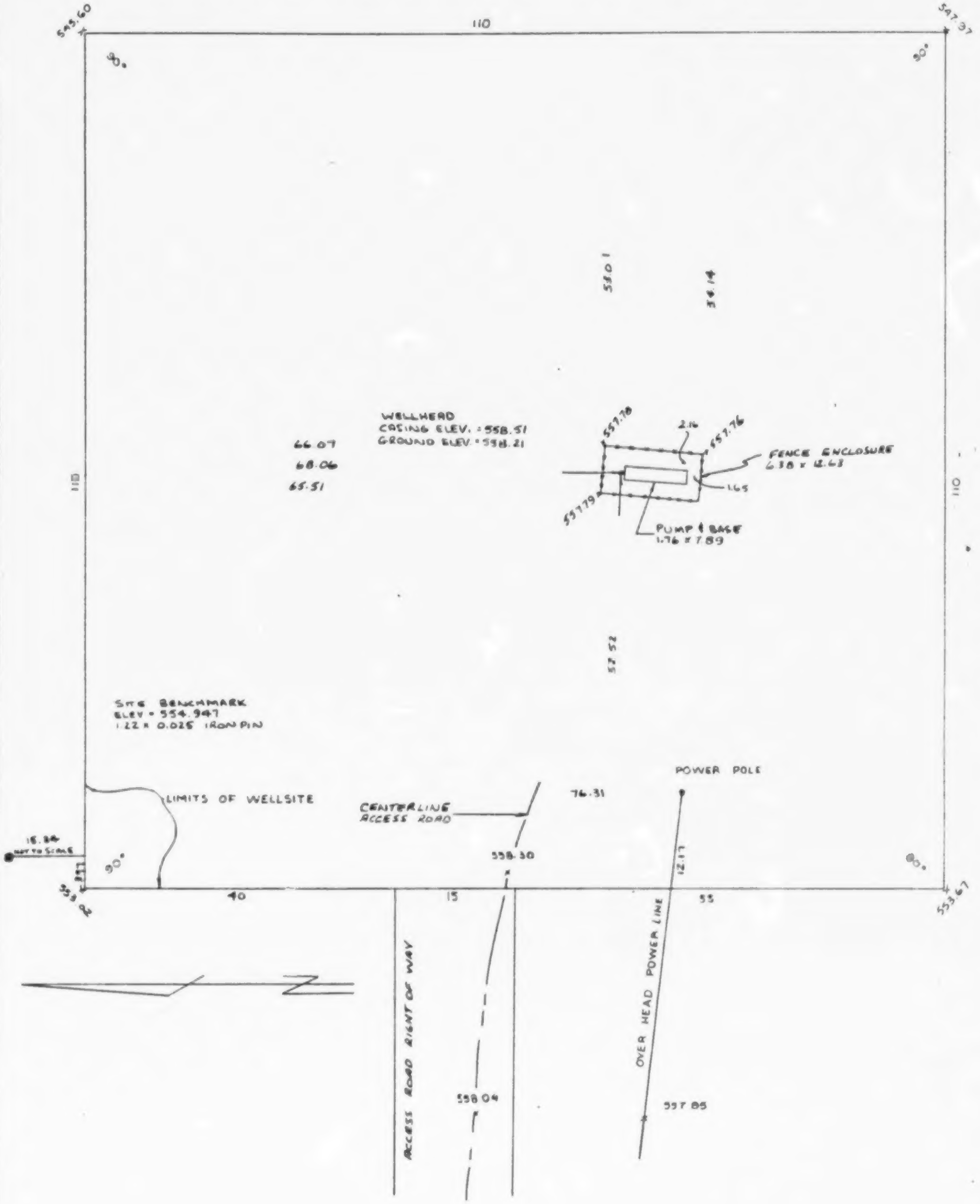
NOTE
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS . . .
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

**PRAIRIE
SURVEYS LTD.**
REGINA, MOOSE JAW

SKETCH PLAN
SHOWING
WELLSITE CON ROXY ET AL HELSWICK
15-33-4-12
LSD/15-SEC33-TWP4-RGE12-W2M

SCALE: 1:500
DATE: Dec. 2. 1986
DRAWN BY: KWK
DRAWING NO.: 2500-2


545.60
110
547.37
90°
90°
58.01
34.14
WELLHEAD
CASING ELEV. = 558.51
GROUND ELEV. = 558.21
66.07
68.06
65.51
557.78
2.16
557.76
FENCE ENCLOSURE
6.38 x 12.63
1.65
557.79
PUMP & BASE
1.76 x 7.89
110
110
52.52
SITE BENCHMARK
ELEV = 554.947
1.22 x 0.025 IRON PIN
POWER POLE
LIMITS OF WELLSITE
CENTERLINE
ACCESS ROAD
76.31
15.84
NOT TO SCALE
90°
558.30
12.17
90°
40
15
55
553.67
ACCESS ROAD RIGHT OF WAY
OVER HEAD POWER LINE
558.04
557.85

NOTE

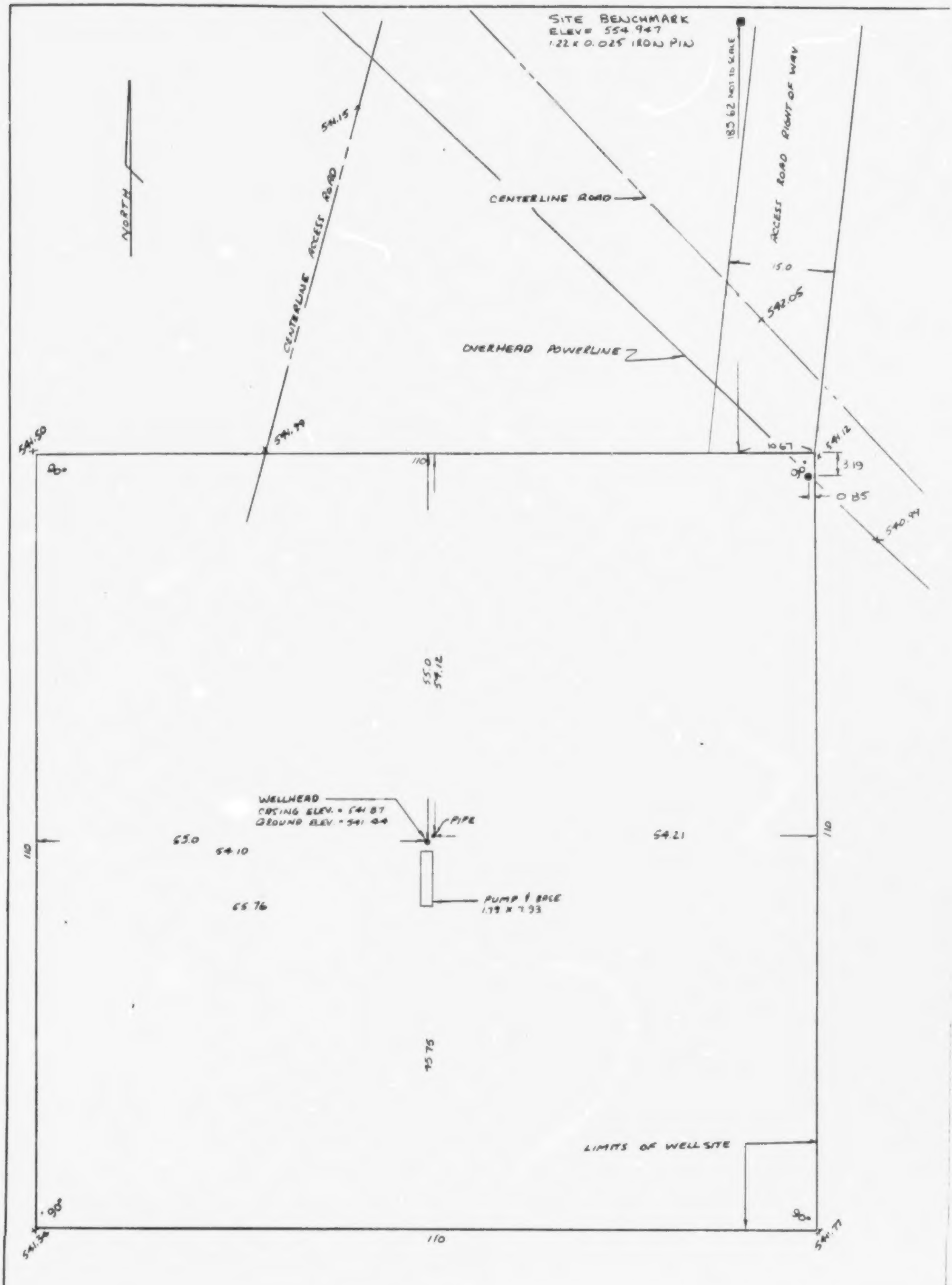
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS.............■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE SURVEYS LTD.
REGINA, MOOSE JAW

SKETCH PLAN
SHOWING
WELLSITE ROXY ET AL W. ELSWICK 13-33-4-12
LSD 13-SEC 33-TWP 4-RGE 12-W2M

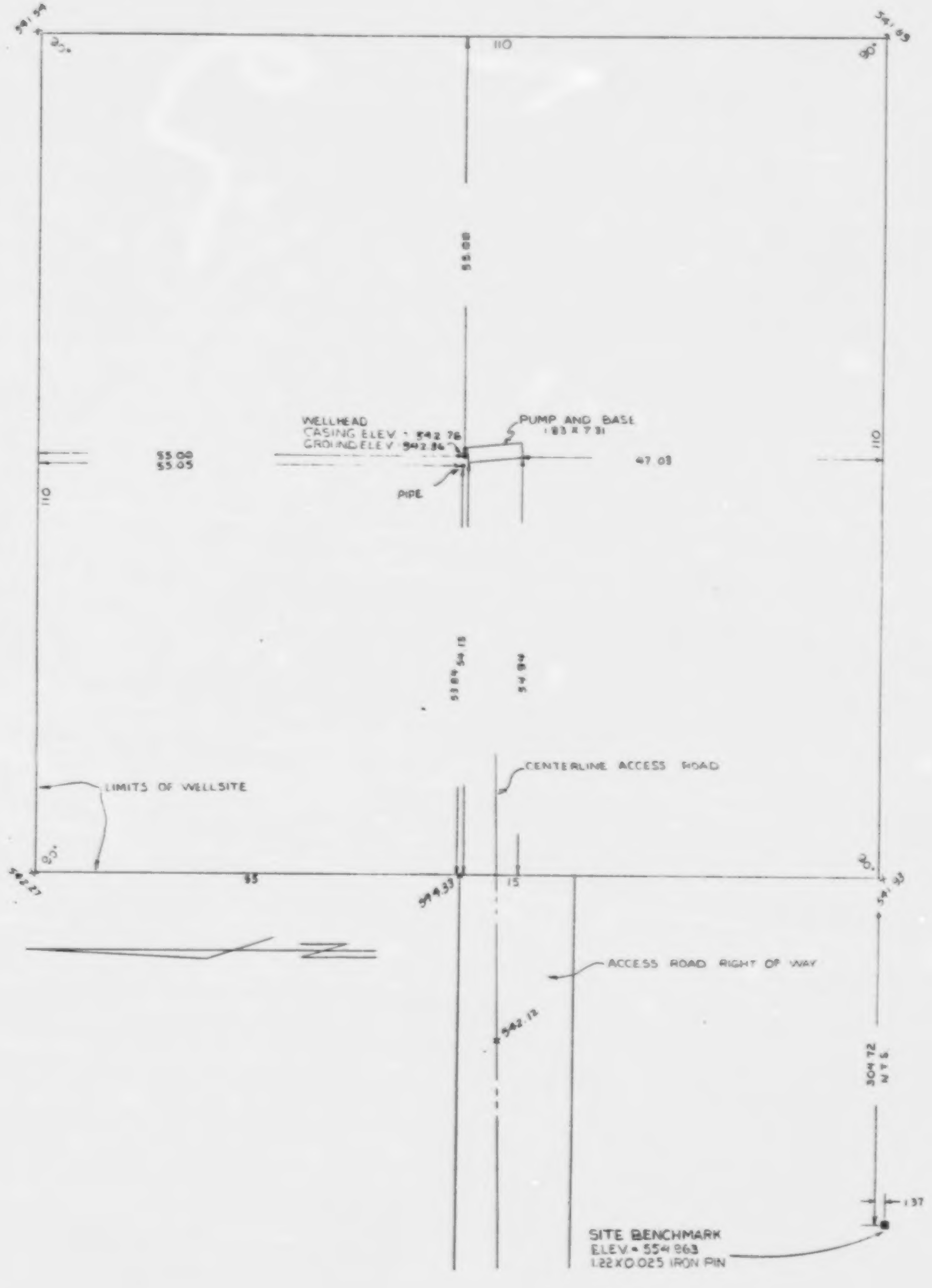
SCALE: 1:500
DATE: DEC. 15, 1986
DRAWN BY: G.A.R.
DRAWING NO.: 2500-3


SITE BENCHMARK
ELEV = 554.947
1.22 x 0.025 IRON PIN
183.62 NOT TO SCALE
NORTH
54.15
CENTERLINE ACCESS ROAD
CENTERLINE ROAD
ACCESS ROAD RIGHT OF WAY
15.0
542.05
OVERHEAD POWERLINE
541.50
541.39
110
10.67
541.12
3.19
0.85
540.94
90°
55.0
54.12
WELLHEAD
CASING ELEV. = 541.87
GROUND ELEV. = 541.44
PIPE
65.0
54.10
54.21
PUMP & BASE
1.79 x 7.93
65.76
45.75
LIMITS OF WELLSITE
541.36
541.77

NOTE
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS ...
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE SURVEYS LTD. REGINA, MOOSE JAW	SKETCH PLAN SHOWING WELLSITE CON. ROXY ET AL N. ELSWICK 3-4-5-12 LSD3 -SEC 4 - TWP 5 - RGE 12 - W2M	SCALE: 1:500 DATE: DEC 2, 1986 DRAWN BY: KWK DRAWING NO.: 2500-4


541.54
90°
110
541.69
90°
55.08
WELLHEAD
CASING ELEV = 542.76
GROUND ELEV 542.36
PUMP AND BASE
1.83 X 7.31
55.00
55.05
47.03
110
110
PIPE
53.84
54.15
54.84
CENTERLINE ACCESS ROAD
LIMITS OF WELLSITE
90°
542.27
55
544.33
15
90°
541.93
ACCESS ROAD RIGHT OF WAY
542.12
304.72
N.T.S.
1.37
SITE BENCHMARK
ELEV. = 554.863
1.22 X 0.025 IRON PIN

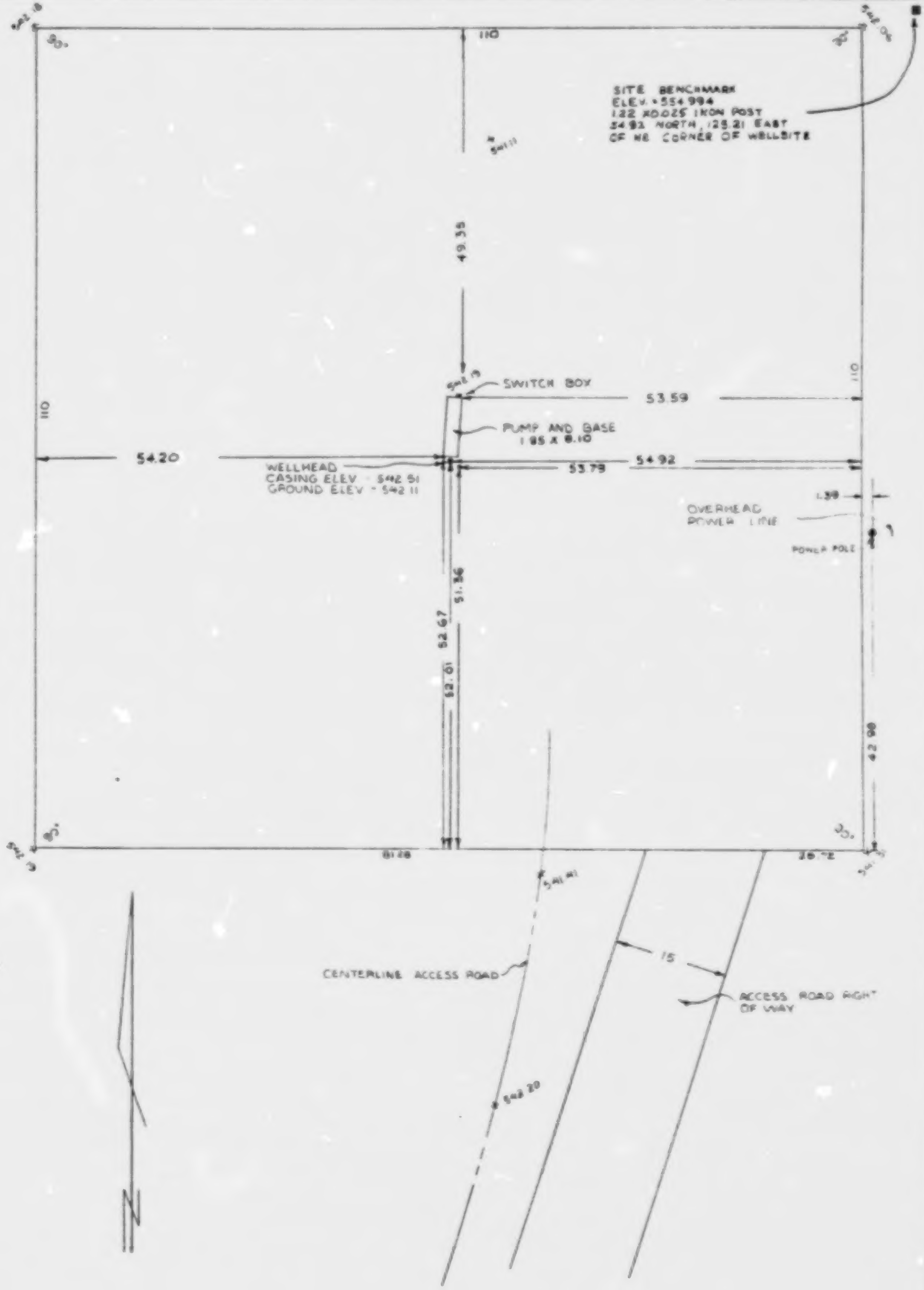
NOTE
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS .
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE SURVEYS LTD.
REGINA, MOOSE JAW

SKETCH PLAN
SHOWING
WELLSITE
ROXY ET AL N ELSWICK
5-4-5-12
LSD/5 -SEC 4 -TWP 5 -RGE 12 -W2M

SCALE: 1:500
DATE: DEC 16 /1986
DRAWN BY: JVZ
DRAWING NO.: 2500-5


542.8
90°
110
542.06
90°
SITE BENCHMARK
ELEV. = 554.994
1.22 X0.025 IRON POST
54.92 NORTH, 125.21 EAST
OF NE CORNER OF WELLSITE
541.11
49.35
542.13
SWITCH BOX
53.59
110
110
PUMP AND BASE
1.95 X 8.10
54.20
54.92
WELLHEAD
CASING ELEV. = 542.51
GROUND ELEV. = 542.11
53.79
1.38
OVERHEAD
POWER LINE
POWER POLE
51.36
52.67
52.01
42.98
90°
90°
81.28
26.72
541.41
15
CENTERLINE ACCESS ROAD
ACCESS ROAD RIGHT OF WAY
542.20
N

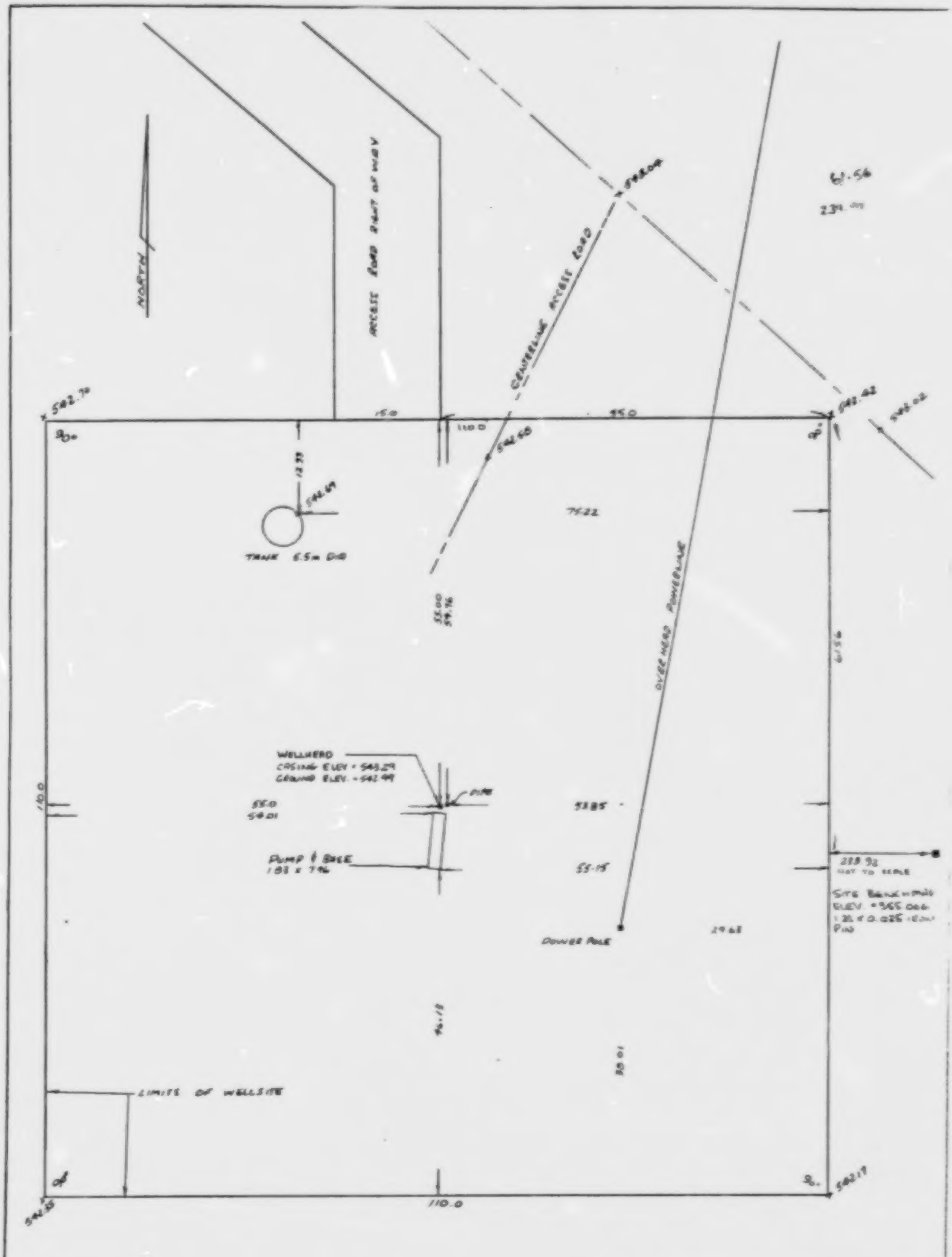
NOTE
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS.... . . . ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE
SURVEYS LTD.
REGINA, MOOSE JAW

SKETCH PLAN
SHOWING
WELLSITE
ROXY ET AL N. ELSWICK
9-5-5-12
LSD/9 - SEC 5 - TWP 5 - RGE 12 - W2M

SCALE: 1:500
DATE: DEC 16 1986
DRAWN BY: JVZ
DRAWING NO.: 2500-6

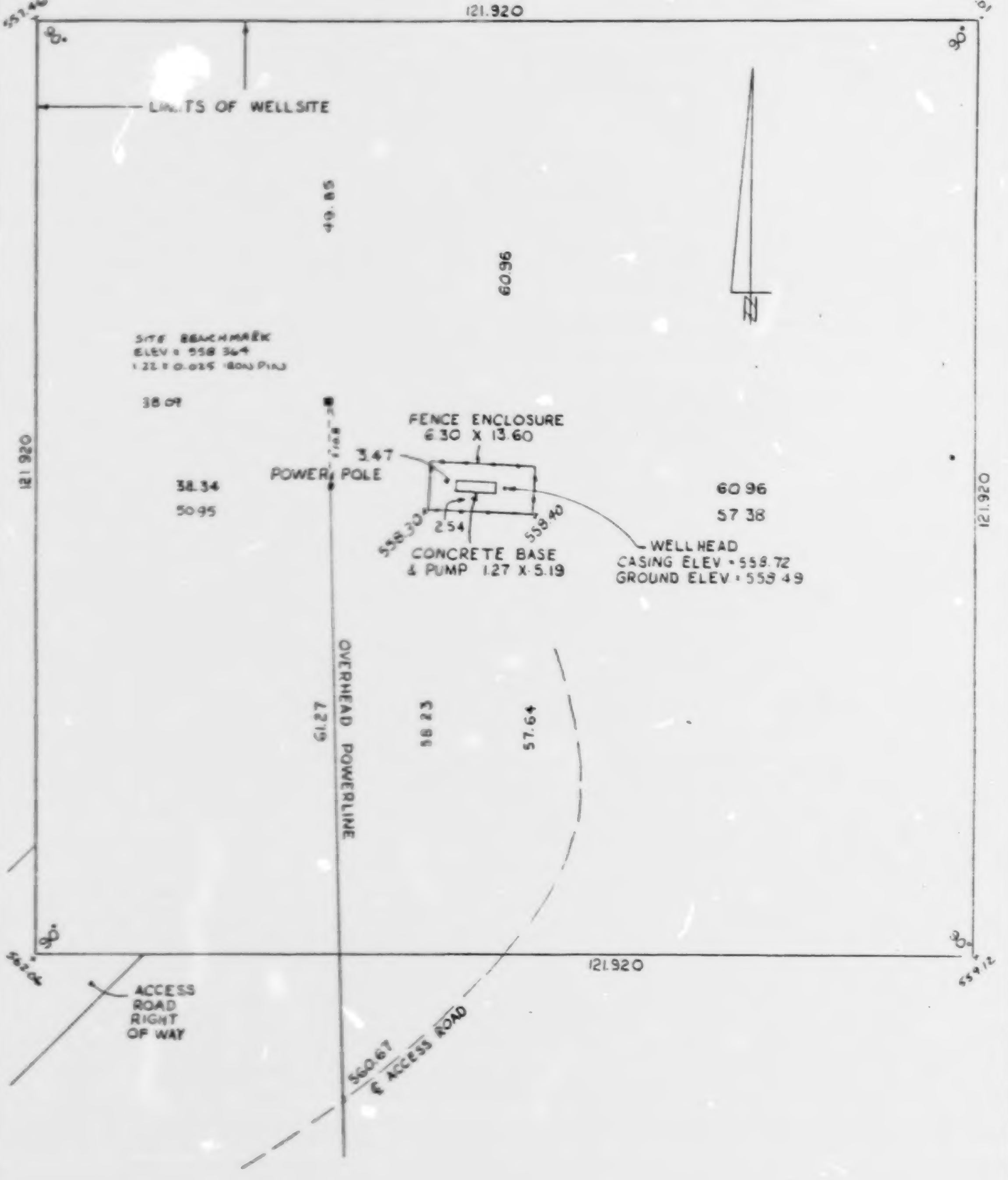

NORTH
ACCESS ROAD RIGHT OF WAY
CENTERLINE ACCESS ROAD
ERROR
OVERHEAD POWERLINE
61.56
239.00
x 542.70
15.0
110.0
55.0
x 542.42
542.02
542.60
12.75
542.64
75.22
TANK 6.5m DIA
55.00
54.76
61.56
110.0
WELLHEAD
CASING ELEV = 543.29
GROUND ELEV. = 542.99
PIPE
55.0
54.01
53.85
PUMP & BASE
1.83 x 7.96
55.15
233.92
NOT TO SCALE
SITE BENCHMARK
ELEV. = 565.006
1.35 x 0.025 IRON PIN
POWER POLE
29.68
46.12
30.01
LIMITS OF WELLSITE
110.0
542.35
542.19

NOTE

DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS ....
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE SURVEYS LTD. REGINA, MOOSE JAW	SKETCH PLAN SHOWING WELLSITE BOW V ET AL N. ELSWICK 15-5-5-12 LSD 15 - SEC 5 - TWP 5 - RGE 12 - W2M	SCALE: 1:500 DATE: DEC. 2. 1986 DRAWN BY: EWK DRAWING NO.: 2500-7


557.46
121.920
557.01
90°
90°
LIMITS OF WELLSITE
49.85
60.96
N
SITE BENCHMARK
ELEV = 558.364
1.22 ± 0.025 IRON PIN
38.09
FENCE ENCLOSURE
6.30 X 13.60
3.47
POWER POLE
121.920
38.34
50.95
558.30
2.54
558.40
60.96
57.38
121.920
CONCRETE BASE
& PUMP 1.27 X 5.19
WELLHEAD
CASING ELEV = 558.72
GROUND ELEV = 558.49
OVERHEAD POWERLINE
61.27
58.23
57.64
90°
90°
562.06
121.920
559.12
ACCESS
ROAD
RIGHT
OF WAY
560.67
℄ ACCESS ROAD

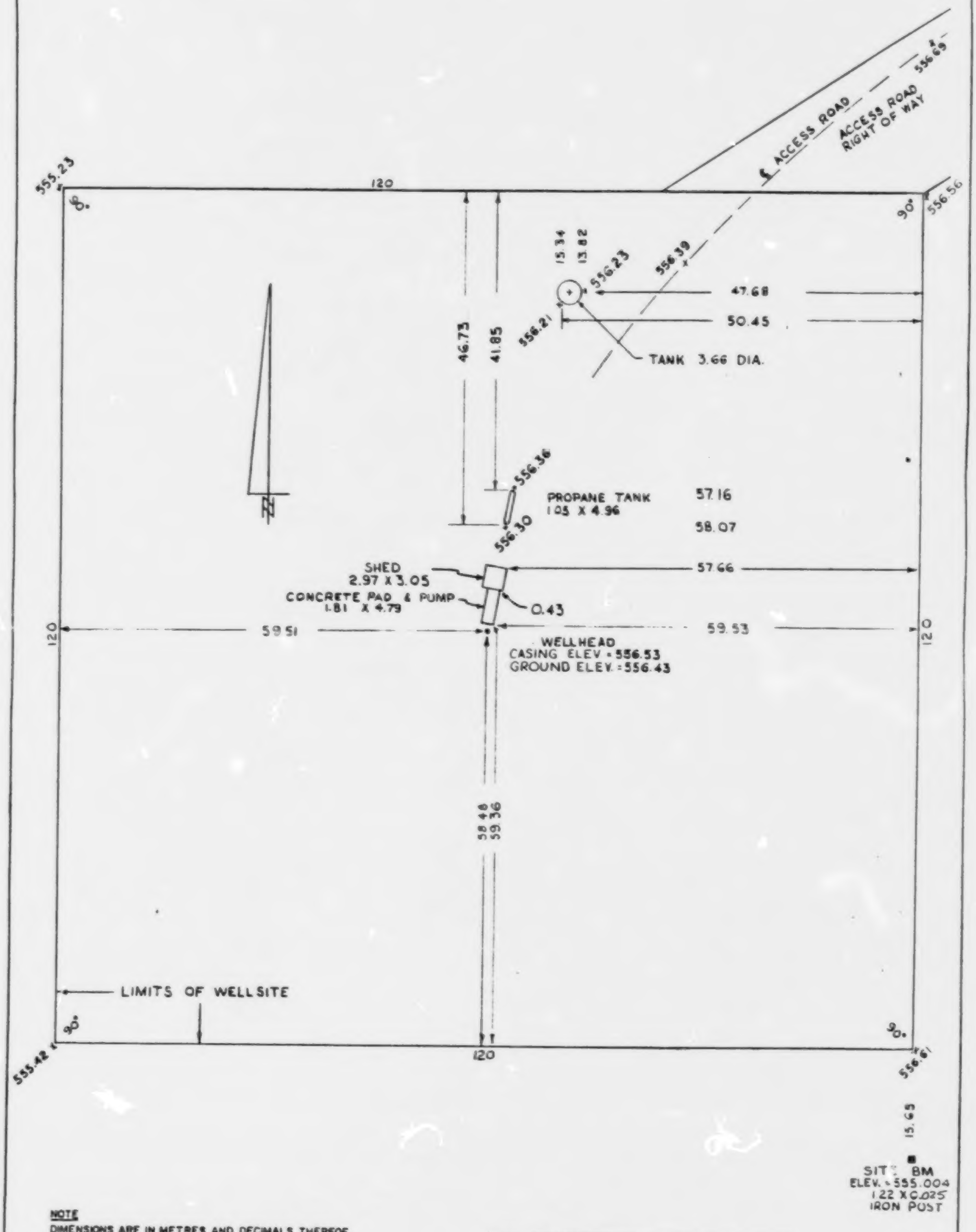
NOTE
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS . . . . . ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE SURVEYS LTD.
REGINA, MOOSE JAW

SKETCH PLAN
SHOWING PANCANADIAN UNIT
WELLSITE CENTRAL DEL RIO - H.B.
RALPH NO. 16-8
LSD 16 - SEC 8 - TWP 7 - RGE 13 - W2M

SCALE: 1:500
DATE: NOV. 17, 1986
DRAWN BY: G.A.R.
DRAWING NO.: 2500-8



555.23
90°
120
℄ ACCESS ROAD
ACCESS ROAD RIGHT OF WAY
556.69
556.56
90°
15.34
13.82
556.23
556.39
556.21
47.68
50.45
TANK 3.66 DIA.
46.73
41.85
556.36
556.30
PROPANE TANK
1.05 X 4.96
57.16
58.07
SHED
2.97 X 3.05
CONCRETE PAD & PUMP
1.81 X 4.79
0.43
57.66
120
59.51
59.53
120
WELLHEAD
CASING ELEV = 556.53
GROUND ELEV = 556.43
58.48
59.36
LIMITS OF WELLSITE
90°
90°
555.42
120
556.61
15.65
SITE BM
ELEV = 555.004
1.22 X 0.025
IRON POST

NOTE

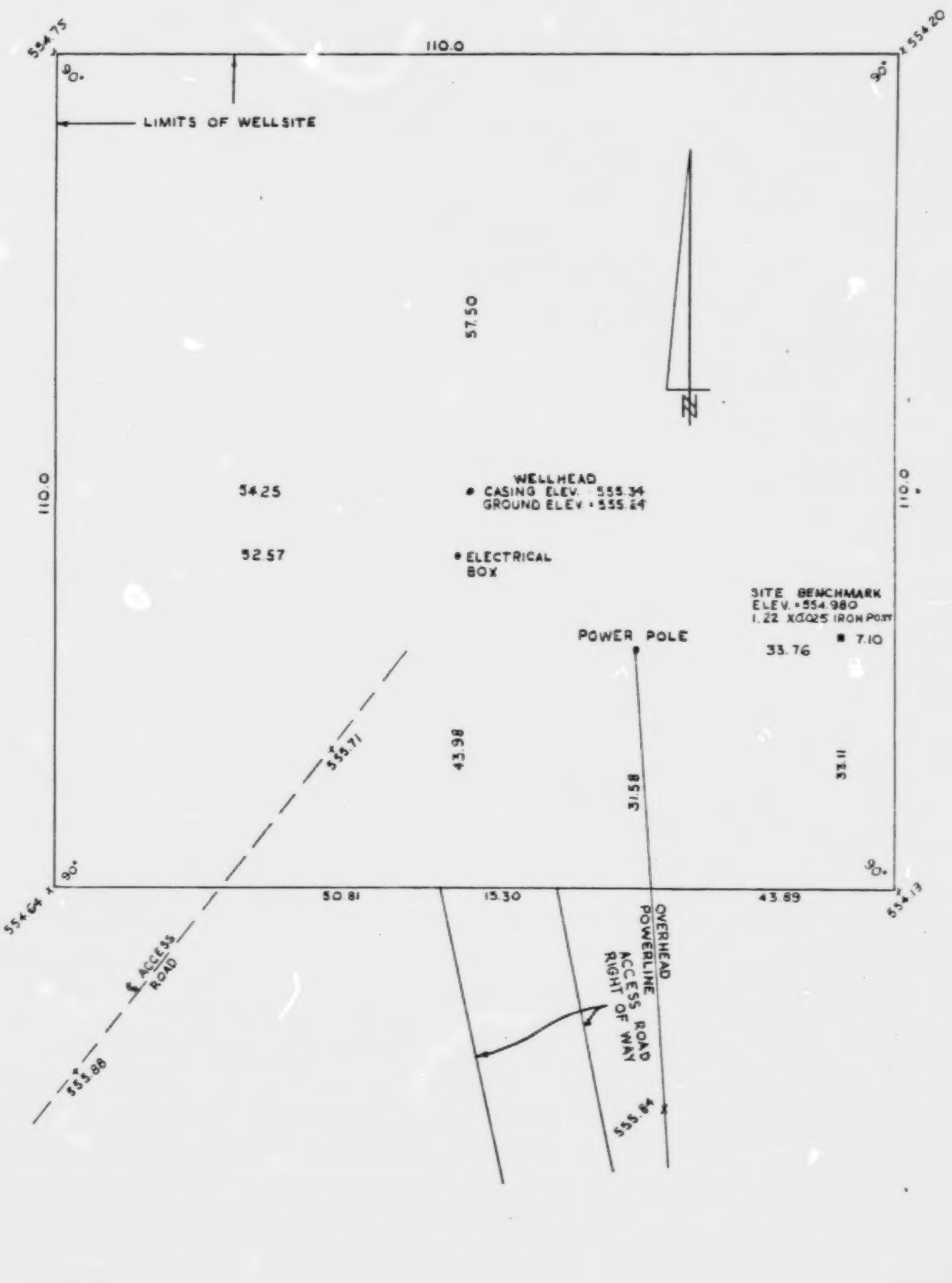
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS . . . . ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE SURVEYS LTD.
REGINA, MOOSE JAW

SKETCH PLAN
SHOWING
WELLSITE PCP WEYBURN 10-9-7-13
LSD 10 - SEC 9 - TWP 7 - RGE 13 - W2M

SCALE: 1:500
DATE: NOV 14, 1986
DRAWN BY: G.A.R.
DRAWING NO.: 2500-09


554.75
110.0
x 554.20
90°
90°
LIMITS OF WELLSITE
57.50
110.0
110.0
54.25
WELLHEAD
CASING ELEV. 555.34
GROUND ELEV. 555.24
52.57
ELECTRICAL BOX
SITE BENCHMARK
ELEV. 554.980
1.22 X 0.025 IRON POST
POWER POLE
33.76
7.10
555.71
43.98
31.58
33.11
90°
90°
554.64
50.81
15.30
43.89
554.13
℄ ACCESS ROAD
OVERHEAD POWERLINE
ACCESS ROAD RIGHT OF WAY
555.88
555.84

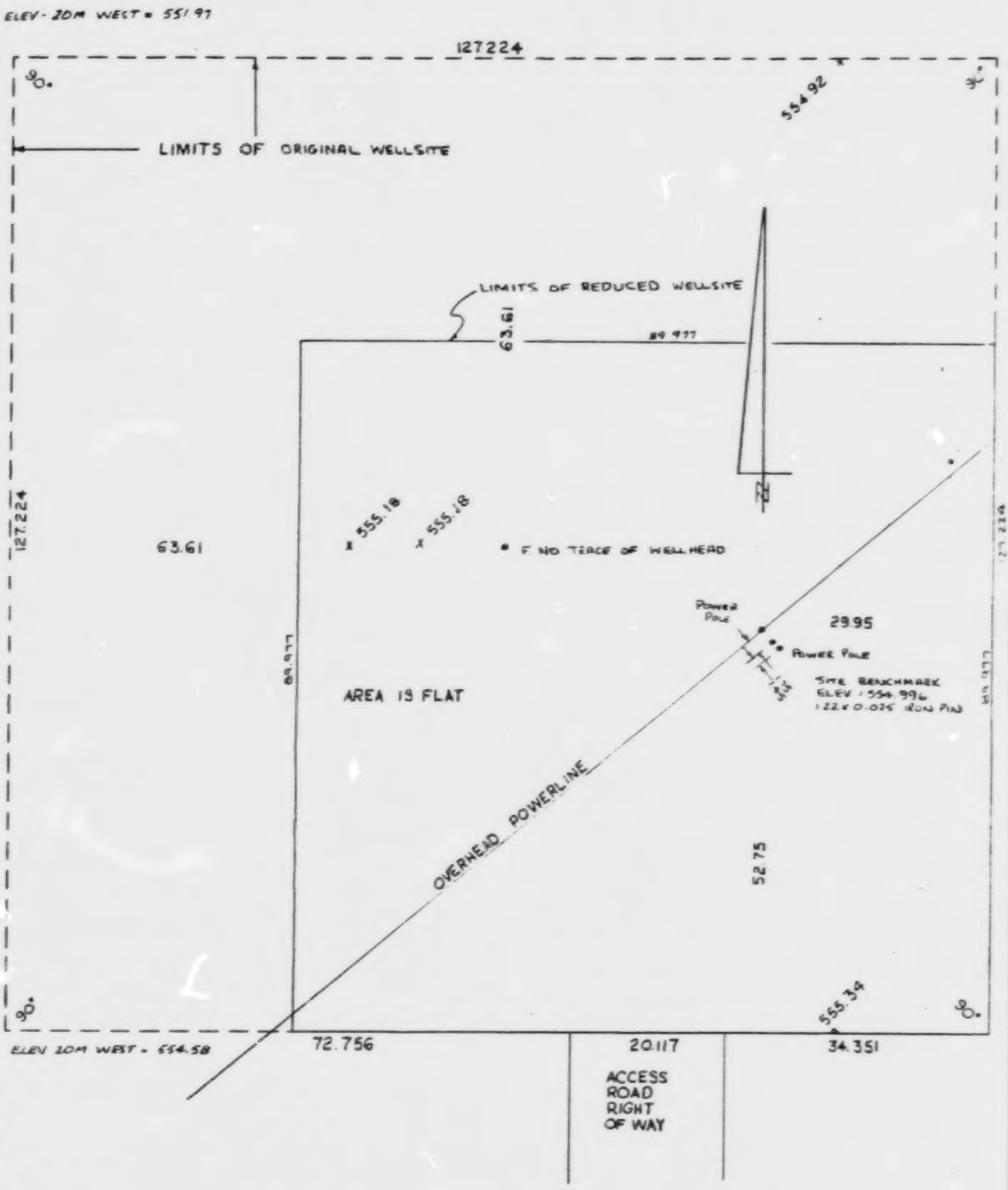
NOTE
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS . . . ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE SURVEYS LTD.
REGINA, MOOSE JAW

SKETCH PLAN
SHOWING
WELLSITE OMEGA WEYBURN 8-9-7-13
LSD 8 - SEC 9 - TWP 7 - RGE 13 - W2M

SCALE: 1:500
DATE: NOV. 17, 1986
DRAWN BY: G.A.R.
DRAWING NO.: 2500-10


ELEV - 20M WEST = 551.97
127.224
554.92
LIMITS OF ORIGINAL WELLSITE
LIMITS OF REDUCED WELLSITE
63.61
89.977
127.224
63.61
555.18
555.18
F NO TRACE OF WELLHEAD
POWER POLE
POWER POLE
29.95
SITE BENCHMARK
ELEV : 554.996
1.22 x 0.025 IRON PIN
89.977
89.977
127.224
AREA IS FLAT
OVERHEAD POWERLINE
52.75
555.34
ELEV 20M WEST - 554.58
72.756
20.117
34.351
ACCESS
ROAD
RIGHT
OF WAY

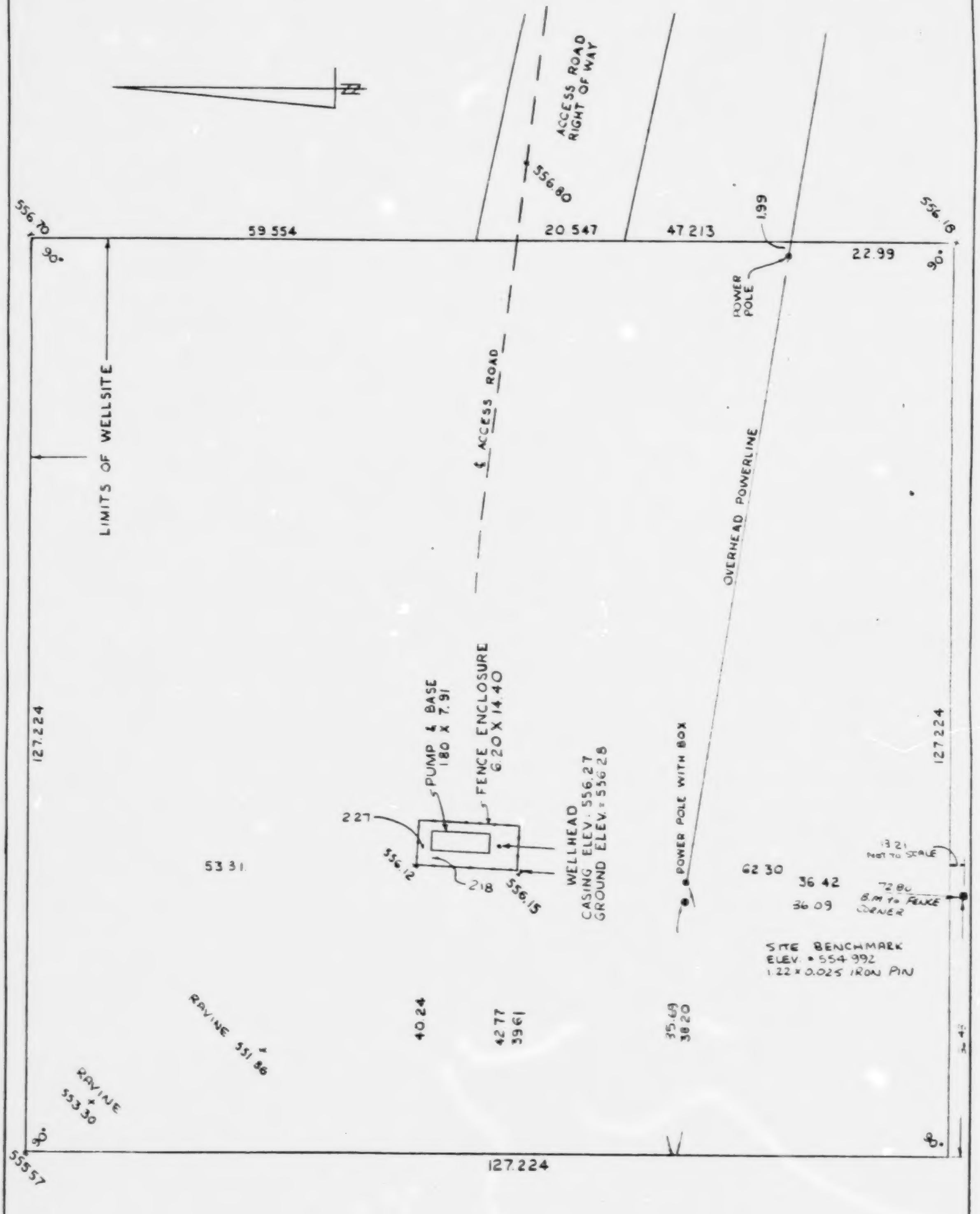
NOTE
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS . . . . ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE
SURVEYS LTD.
REGINA, MOOSE JAW

SKETCH PLAN
SHOWING
WELLSITE- CDR GILBERT WEYBURN 4-10-7-13
LSD 4 -SEC 10 - TWP 7 - RGE 13 - W2M

SCALE: 1:500
DATE: NOV. 18, 1986
DRAWN BY: G.A.R.
DRAWING NO.: 2500-11

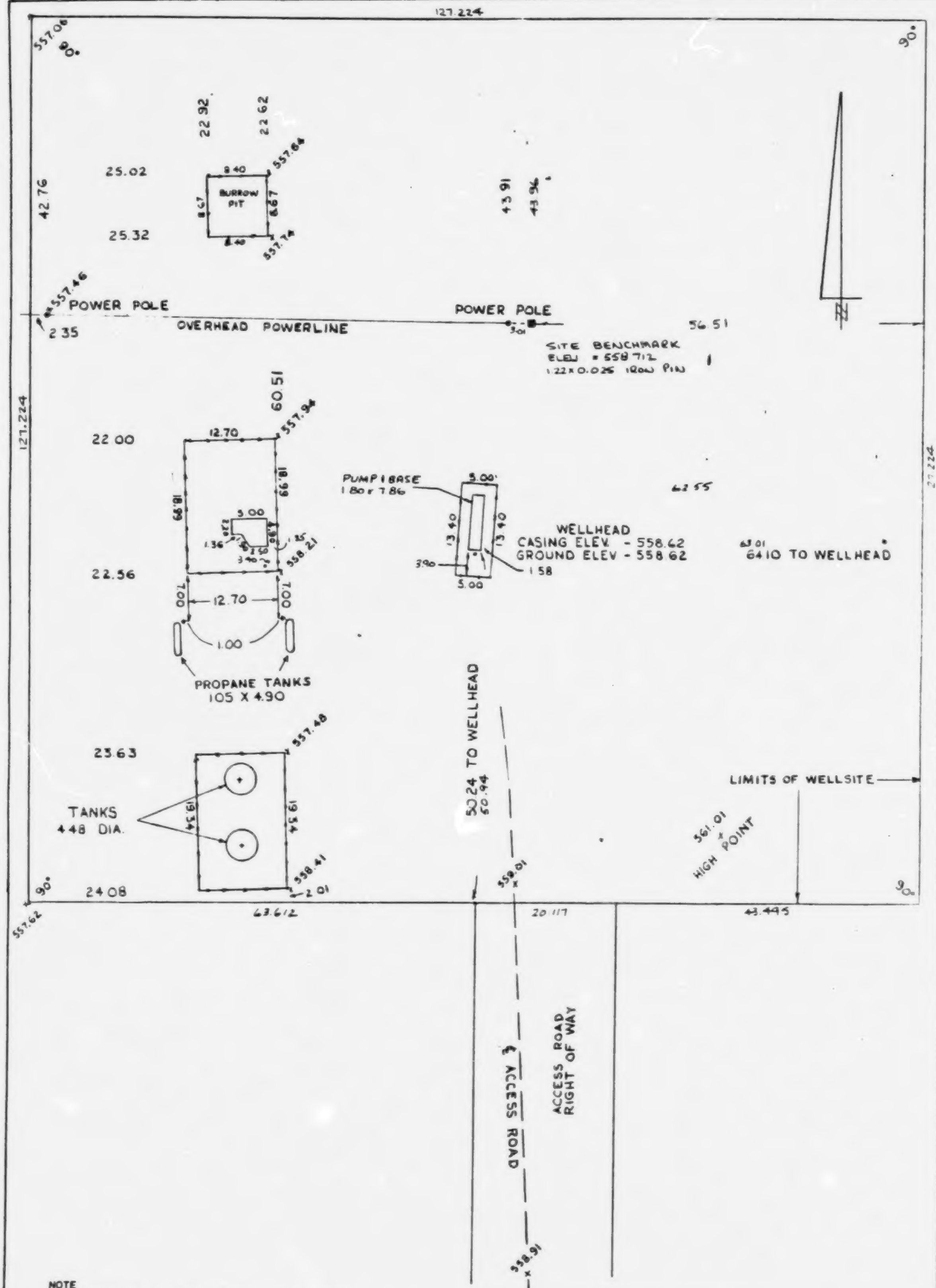

N
ACCESS ROAD RIGHT OF WAY
556.80
556.70
59.554
20.547
47.213
1.99
556.18
22.99
90°
POWER POLE
LIMITS OF WELLSITE
℄ ACCESS ROAD
OVERHEAD POWERLINE
127.224
PUMP & BASE 1.80 X 7.91
FENCE ENCLOSURE 6.20 X 14.40
2.27
2.18
556.12
556.15
WELLHEAD
CASING ELEV. 556.27
GROUND ELEV. = 556.28
POWER POLE WITH BOX
53.31
62.30
36.42
36.09
3.21 NOT TO SCALE
72.80 B.M. TO FENCE CORNER
SITE BENCHMARK
ELEV. = 554.992
1.22 x 0.025 IRON PIN
RAVINE 551.86
RAVINE 553.30
40.24
42.77
39.61
35.69
38.20
555.57
127.224

NOTE

DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS .
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

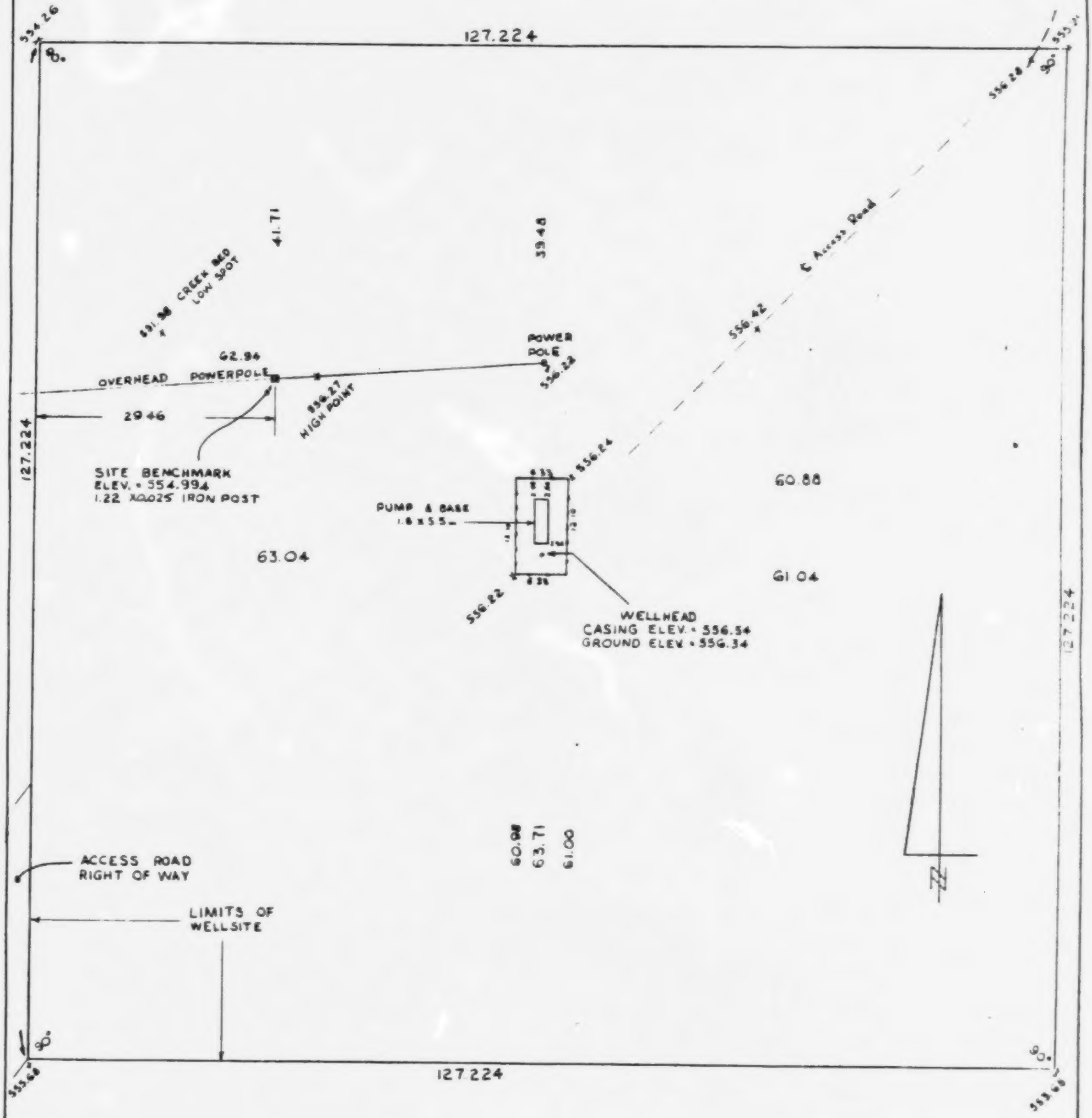
PRAIRIE SURVEYS LTD. REGINA, MOOSE JAW	SKETCH PLAN SHOWING WELLSITE MURPHY WEYBURN 14-3-7-13 LSD 14 - SEC 3 - TWP 7 - RGE 13 - W2M	SCALE: 1:500 DATE: NOV. 18, 1986 DRAWN BY: G.A.R. DRAWING NO.: 2500-12


127.224
557.06
90°
90°
22.92
22.62
25.02
8.40
557.64
BURROW PIT
8.67
8.67
42.76
43.91
43.96
25.32
8.40
557.74
557.46
POWER POLE
2.35
OVERHEAD POWERLINE
POWER POLE
3.01
56.51
SITE BENCHMARK
ELEV = 558.712
1.22 X 0.025 IRON PIN
60.51
12.70
557.94
127.224
22.00
18.91
18.91
PUMP BASE
1.80 x 7.86
5.00
62.55
5.00
WELLHEAD
CASING ELEV. - 558.62
GROUND ELEV - 558.62
13.40
13.40
63.01
64.10 TO WELLHEAD
127.224
1.36
2.50
3.40
1.35
558.21
3.90
1.58
5.00
22.56
7.00
12.70
7.00
1.00
PROPANE TANKS
1.05 X 4.90
50.24 TO WELLHEAD
50.94
557.48
23.63
TANKS
4.48 DIA.
19.34
19.34
LIMITS OF WELLSITE
561.01
HIGH POINT
558.41
2.01
559.01
90°
90°
24.08
557.62
63.612
20.117
43.495
℄ ACCESS ROAD
ACCESS ROAD RIGHT OF WAY
558.91

NOTE
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS ....
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE SURVEYS LTD. REGINA, MOOSE JAW	SKETCH PLAN SHOWING WELLSITE MURPHY WEYBURN LSD 2 - SEC 10 - TWP 7 - RGE 13 - W2M	SCALE: 1:500 DATE: NOV. 18, 1986 DRAWN BY: G.A.R. DRAWING NO.: 2500-13


554.26
127.224
90°
556.28
90°
41.71
39.48
551.98 CREEK BED LOW SPOT
℄ Access Road
556.42
62.94
POWER POLE
556.22
OVERHEAD POWERPOLE
29.46
556.27 HIGH POINT
127.224
SITE BENCHMARK
ELEV. = 554.994
1.22 X0.025 IRON POST
556.24
60.88
PUMP & BASE
1.8 x 5.5
63.04
61.04
556.22
WELLHEAD
CASING ELEV. = 556.54
GROUND ELEV. = 556.34
127.224
60.98
63.71
61.00
N
ACCESS ROAD
RIGHT OF WAY
LIMITS OF
WELLSITE
90°
555.68
127.224
90°
553.68

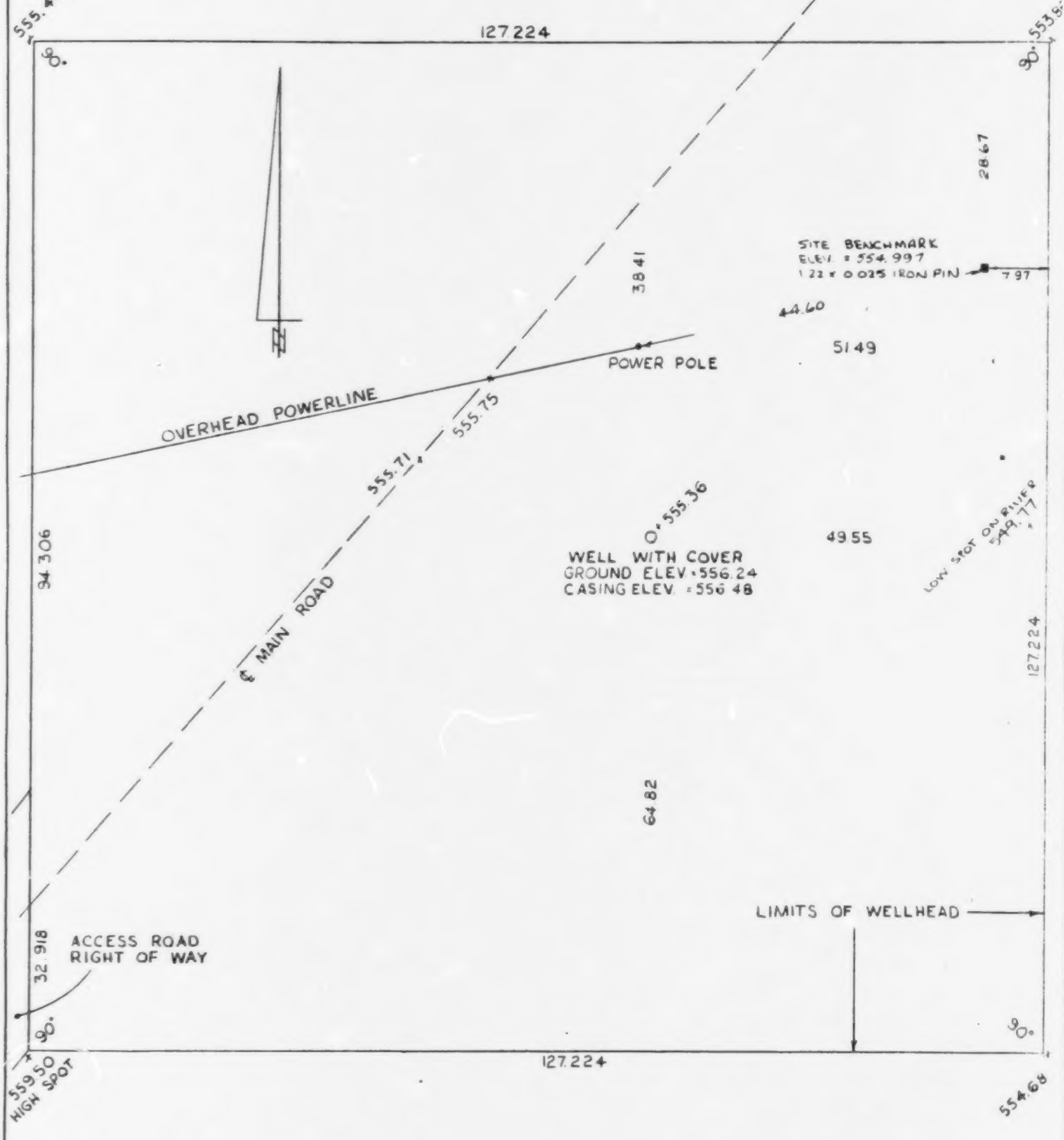
NOTE
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS . . . ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE
SURVEYS LTD.
REGINA, MOOSE JAW

SKETCH PLAN
SHOWING
WELLSITE
PANCANADIAN UNIT
CENTRAL - DEL RIO
RALPH 10-3
LSD 10 - SEC 3 - TWP 7 - RGE 13 - W2M

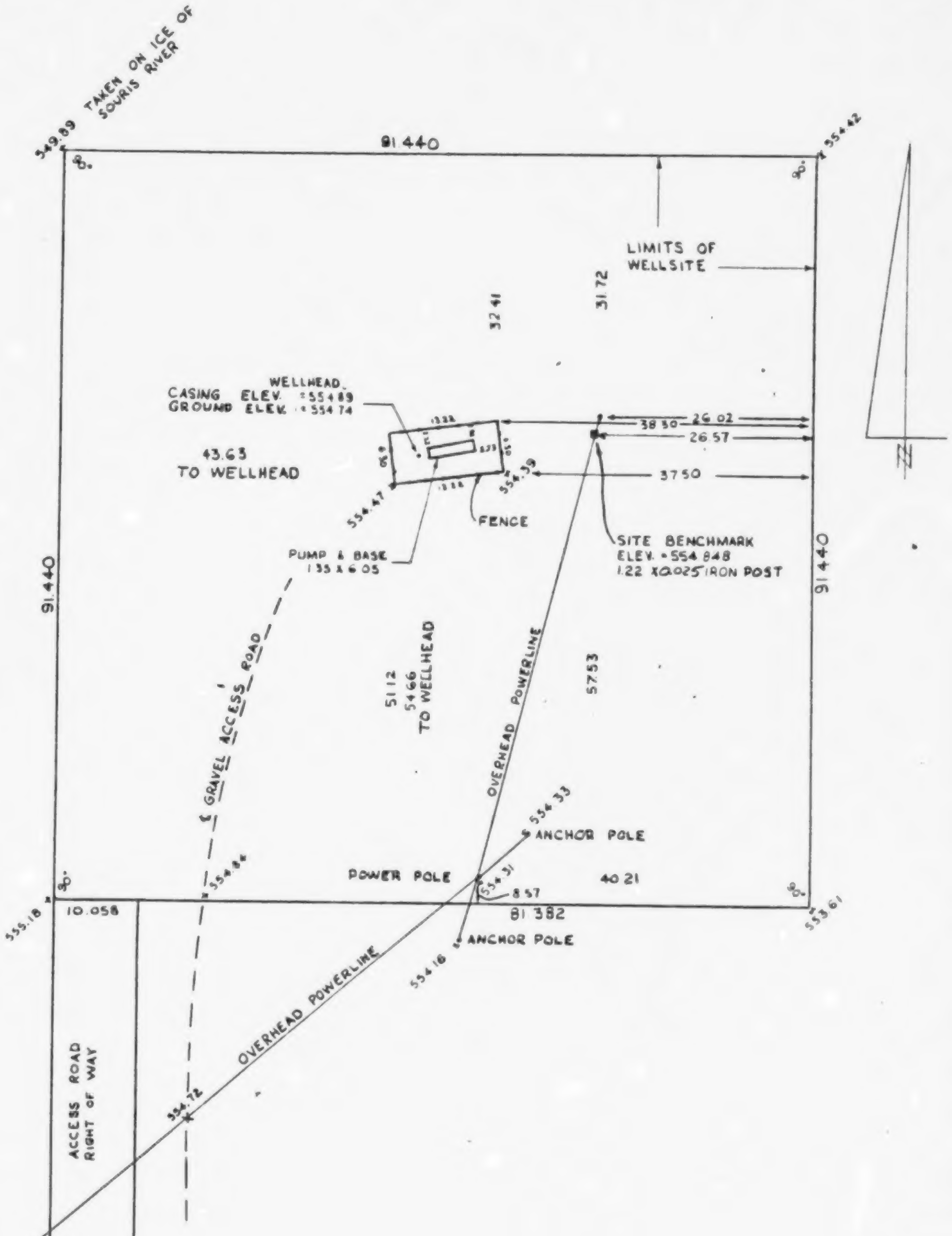
SCALE: 1:500
DATE: NOV. 19, 1986
DRAWN BY: G.A.R.
DRAWING NO.: 2500-15


555.40
127.224
8.
90.
553.8
28.67
SITE BENCHMARK
ELEV. = 554.997
1.22 x 0.025 IRON PIN
7.97
38.41
44.60
51.49
POWER POLE
OVERHEAD POWERLINE
555.75
555.71
O 555.36
WELL WITH COVER
GROUND ELEV = 556.24
CASING ELEV. = 556.48
49.55
LOW SPOT ON RIVER 549.77
94.306
℄ MAIN ROAD
127.224
64.82
LIMITS OF WELLHEAD
ACCESS ROAD
RIGHT OF WAY
32.918
90.
90.
127.224
559.50
HIGH SPOT
554.68

NOTE
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS ▪.
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE SURVEYS LTD. REGINA, MOOSE JAW	SKETCH PLAN SHOWING PANCANADIAN UNIT MOBIL OIL WELLSITE RALPH X-8-3 LSD 8 - SEC 3 - TWP 7 - RGE 13 - W2M	SCALE: 1:500 DATE: NOV 19, 1986 DRAWN BY: G.A.R. DRAWING NO.: 2500-16


549.89 TAKEN ON ICE OF SOURIS RIVER
91.440
554.42
90°
LIMITS OF WELLSITE
32.41
31.72
WELLHEAD
CASING ELEV. =554.89
GROUND ELEV. =554.74
43.63
TO WELLHEAD
13.22
26.02
38.50
26.57
37.50
554.47
554.39
FENCE
PUMP & BASE
1.35 x 6.05
SITE BENCHMARK
ELEV. =554.848
1.22 x 0.025 IRON POST
91.440
91.440
GRAVEL ACCESS ROAD
51.12
54.66
TO WELLHEAD
OVERHEAD POWERLINE
57.53
554.33
ANCHOR POLE
POWER POLE
554.31
8.57
40.21
554.84
555.18
10.058
81.382
553.61
554.16
ANCHOR POLE
OVERHEAD POWERLINE
ACCESS ROAD RIGHT OF WAY
554.72
N

NOTE

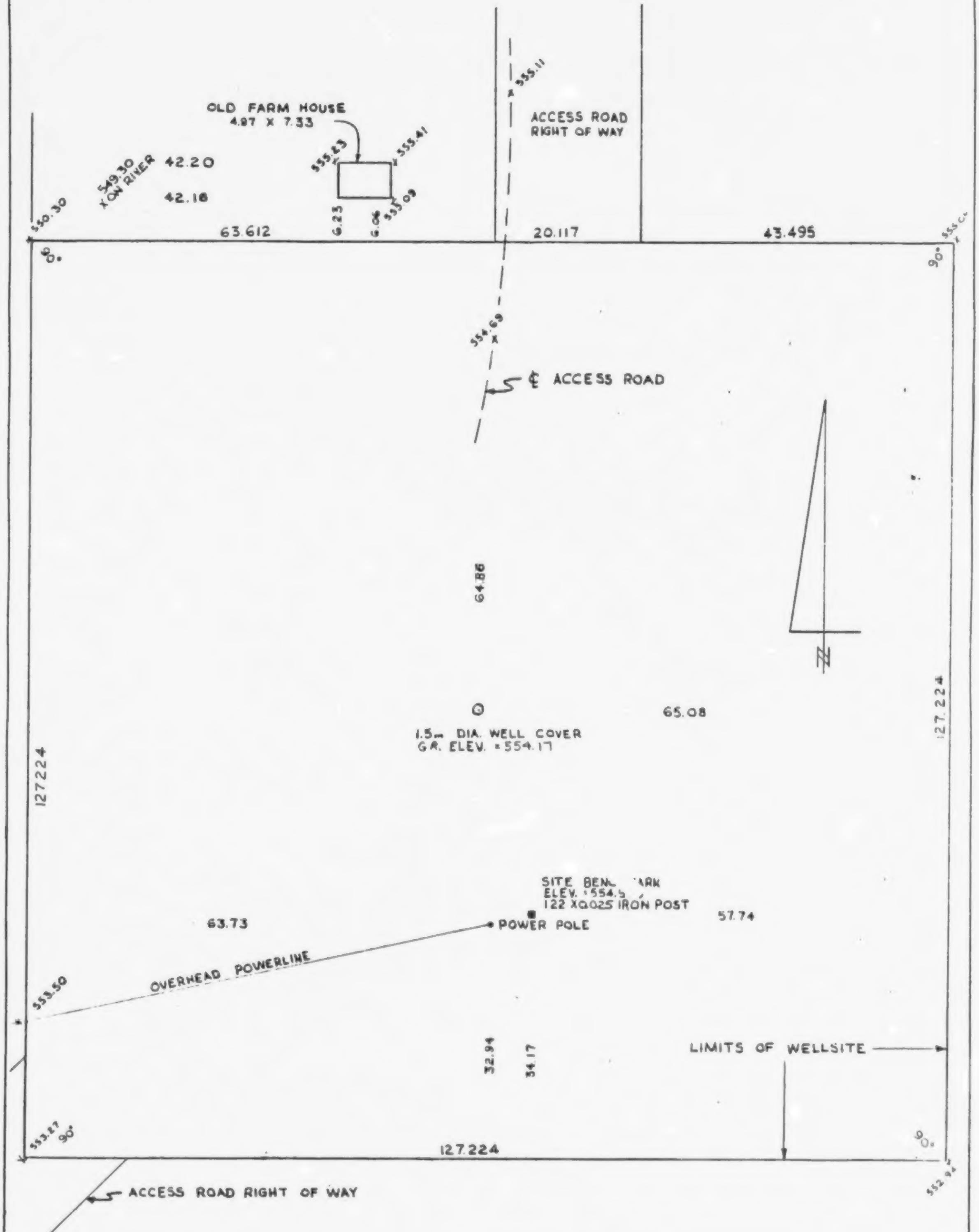
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS .... ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE SURVEYS LTD.
REGINA, MOOSE JAW

SKETCH PLAN
SHOWING PANCANADIAN UNIT
WELLSITE CENTRAL-DEL RIO
RALPH 4-2
LSD 4 -SEC 2 - TWP 7 - RGE 13 - W2M

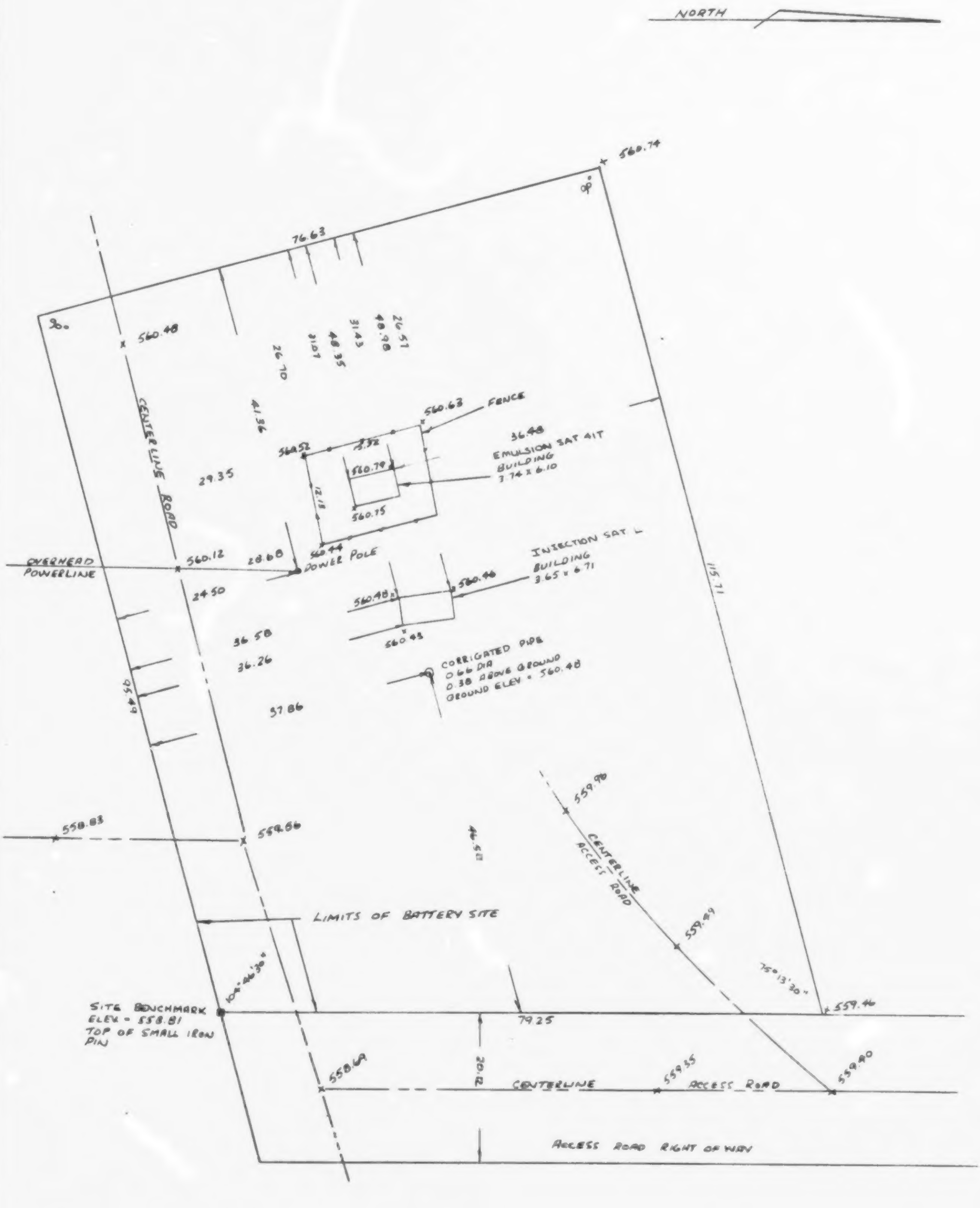
SCALE: 1:500
DATE: NOV. 19, 1986
DRAWN BY: G.A.R.
DRAWING NO.: 2500-17


OLD FARM HOUSE
4.97 X 7.33
555.23
555.41
555.09
6.23
6.08
550.30
549.30
X ON RIVER
42.20
42.16
555.11
ACCESS ROAD
RIGHT OF WAY
63.612
20.117
43.495
90°
555.C
90°
554.69
℄ ACCESS ROAD
64.86
N
1.5m DIA. WELL COVER
GR. ELEV. =554.17
65.08
127.224
127.224
SITE BENCHMARK
ELEV. =554.5
122 X0.025 IRON POST
57.74
63.73
POWER POLE
OVERHEAD POWERLINE
553.50
32.94
34.17
LIMITS OF WELLSITE
553.27
90°
127.224
90°
552.94
ACCESS ROAD RIGHT OF WAY

NOTE
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS . . . . ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE SURVEYS LTD. REGINA, MOOSE JAW	SKETCH PLAN SHOWING WELLSITE BISHOP WEYBURN LSD 16-SEC 34-TWP 6-RGE 13-W2M 16-34	SCALE: 1:500 DATE: NOV. 20, 1986 DRAWN BY: G.A.R. DRAWING NO.: 2500-18


NORTH
560.74
90°
76.63
90°
560.48
26.51
48.98
31.43
31.07
48.35
26.70
41.36
CENTERLINE ROAD
560.63
FENCE
36.48
560.52
3.32
560.79
EMULSION SAT 41T
BUILDING
3.74 x 6.10
29.35
12.18
560.75
560.44
OVERHEAD
POWERLINE
560.12
28.68
POWER POLE
INJECTION SAT L
BUILDING
3.65 x 6.71
560.46
560.48
24.50
560.43
36.58
36.26
CORRIGATED PIPE
0.66 DIA
0.38 ABOVE GROUND
GROUND ELEV = 560.48
95.49
37.86
115.71
559.96
CENTERLINE
ACCESS ROAD
558.83
559.66
46.58
LIMITS OF BATTERY SITE
559.89
104°46'30"
75°13'30"
SITE BENCHMARK
ELEV = 558.81
TOP OF SMALL IRON
PIN
79.25
559.46
20.12
558.69
CENTERLINE
559.35
ACCESS ROAD
559.40
ACCESS ROAD RIGHT OF WAY

NOTE

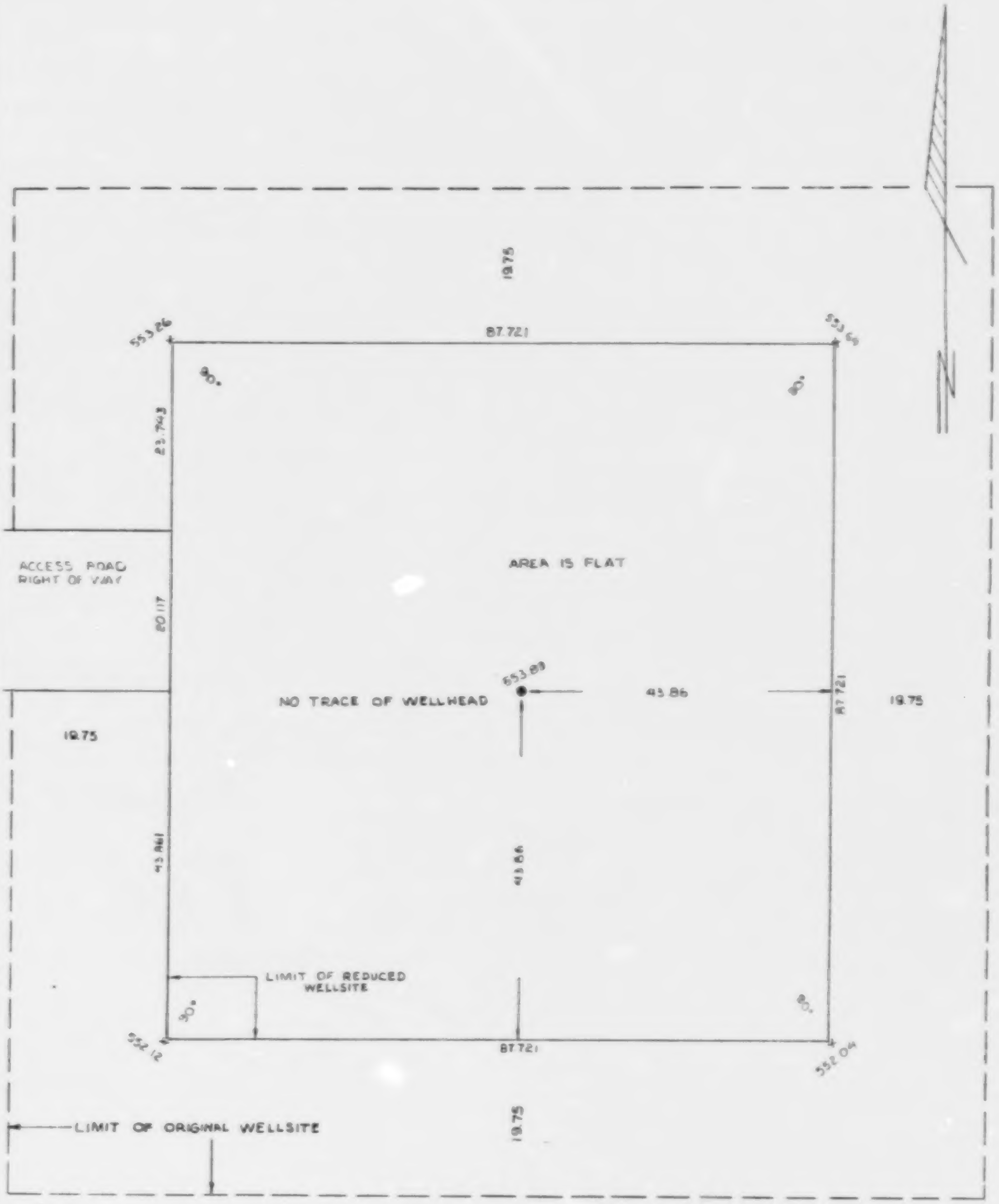
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS ... ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE
SURVEYS LTD.
REGINA, MOOSE JAW

SKETCH PLAN
SHOWING PANCANADIAN
WELLSITE BISHOP WEYBURN BATTERY No. 1
LSD 11-SEC 34-TWP 6-RGE 13-W2M

SCALE: 1:500
DATE: DEC 3, 1986
DRAWN BY: KWK
DRAWING NO.: 2500-19


19.75
553.26
87.721
553.66
90°
90°
23.743
ACCESS ROAD
RIGHT OF WAY
AREA IS FLAT
20.117
553.89
NO TRACE OF WELLHEAD
43.86
87.721
19.75
19.75
43.861
43.86
LIMIT OF REDUCED
WELLSITE
90°
90°
552.12
87.721
552.04
19.75
LIMIT OF ORIGINAL WELLSITE
N

SITE BENCHMARK IS AS DESCRIBED ON
DRAWING 2500-21 FOR WELLSITE MC ALESTER-
GOLDSTON-MOBILE RALPH 8-27 ; 8-27-6-13-2

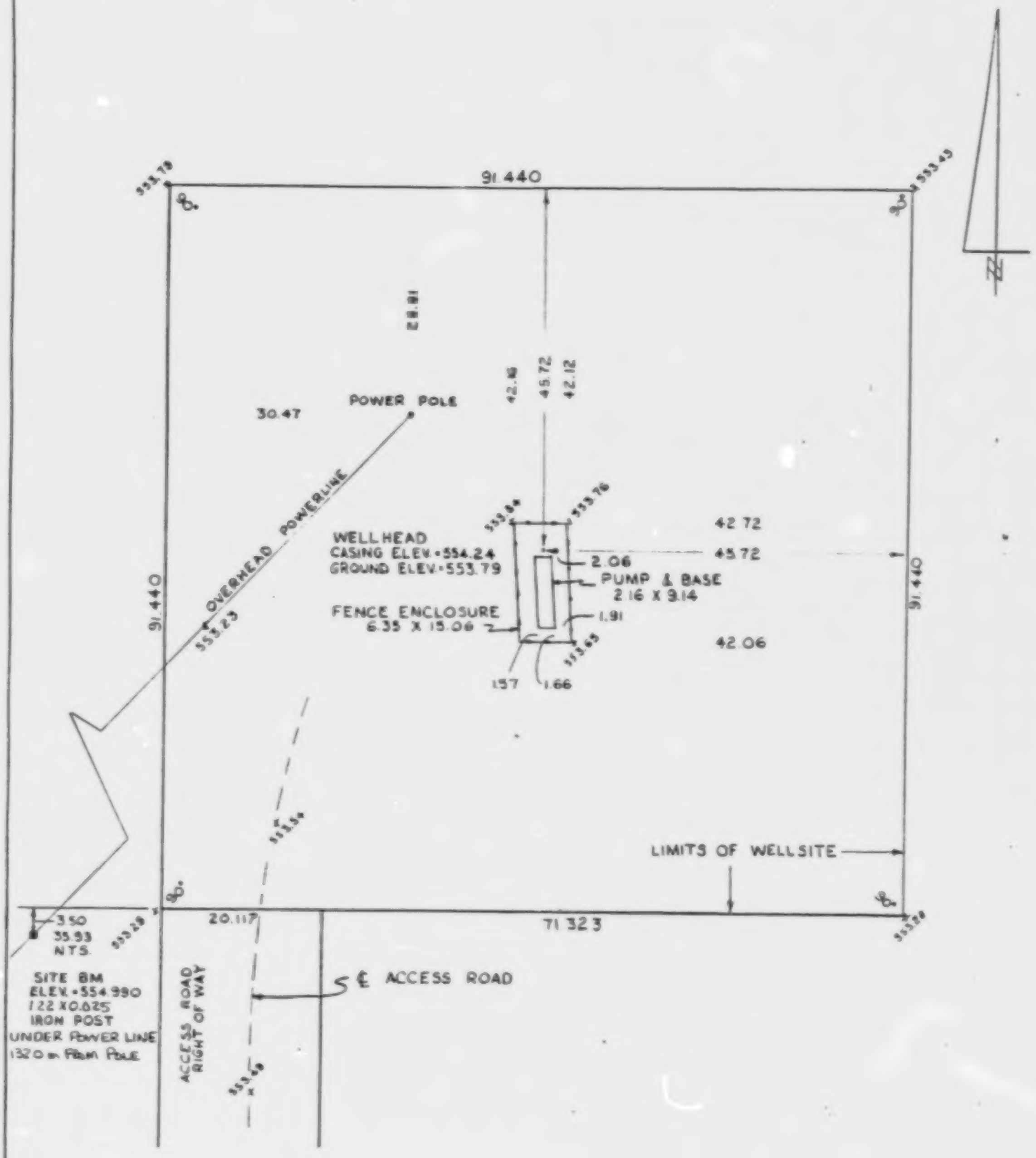
NOTE
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS . . ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE
SURVEYS LTD.
REGINA, MOOSE JAW

SKETCH PLAN
SHOWING
WELLSITE MESA ALTAIR H B WEYBURN 12-26-6-13
LSD 12-SEC26-TWP6-RGE 13-W2M

SCALE: 1:500
DATE: DEC 17, 1986
DRAWN BY: JVZ
DRAWING NO.: 2500-20

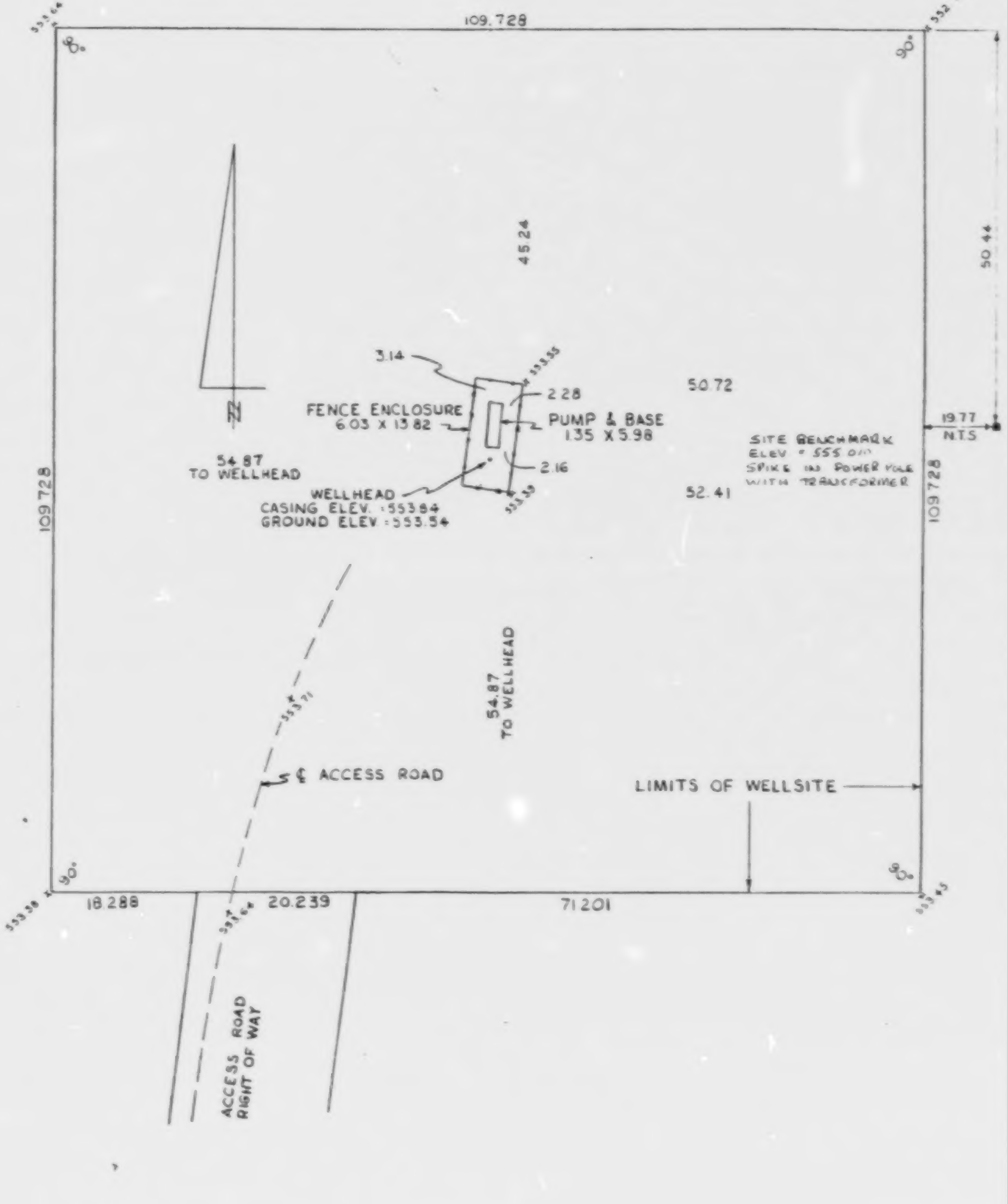

91.440
553.78
553.43
18.83
42.16
45.72
42.12
30.47
POWER POLE
OVERHEAD POWERLINE
553.23
91.440
553.84
553.76
WELLHEAD
CASING ELEV.=554.24
GROUND ELEV.=553.79
FENCE ENCLOSURE
6.35 X 15.06
2.06
PUMP & BASE
2.16 X 9.14
1.91
553.65
1.57
1.66
42.72
45.72
42.06
91.440
553.54
LIMITS OF WELLSITE
3.50
35.93
N.T.S.
553.28
20.117
71.323
553.28
SITE BM
ELEV.=554.990
1.22 X 0.025
IRON POST
UNDER POWER LINE
132.0 m FROM POLE
ACCESS ROAD RIGHT OF WAY
℄ ACCESS ROAD
553.40
N

NOTE

DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS .... ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE SURVEYS LTD. REGINA, MOOSE JAW	SKETCH PLAN SHOWING WELLSITE McALESTER - GOLDSTON - MOBILE RALPH 8-27 LSD 8 - SEC 27 - TWP 6 - RGE 13 - W2M	SCALE: 1:500 DATE: NOV. 20, 1986 DRAWN BY: G.A.R. DRAWING NO.: 2500-21


109.728
90°
90°
553.64
552.77
45.24
50.44
3.14
553.55
2.28
FENCE ENCLOSURE
6.03 X 13.82
PUMP & BASE
1.35 X 5.98
2.16
50.72
52.41
19.77
N.T.S
SITE BENCHMARK
ELEV = 555.010
SPIKE IN POWER POLE
WITH TRANSFORMER
N
54.87
TO WELLHEAD
WELLHEAD
CASING ELEV. :553.84
GROUND ELEV :553.54
553.53
109.728
109.728
54.87
TO WELLHEAD
553.71
℄ ACCESS ROAD
LIMITS OF WELLSITE
90°
90°
553.38
18.288
553.64
20.239
71.201
553.45
ACCESS ROAD
RIGHT OF WAY

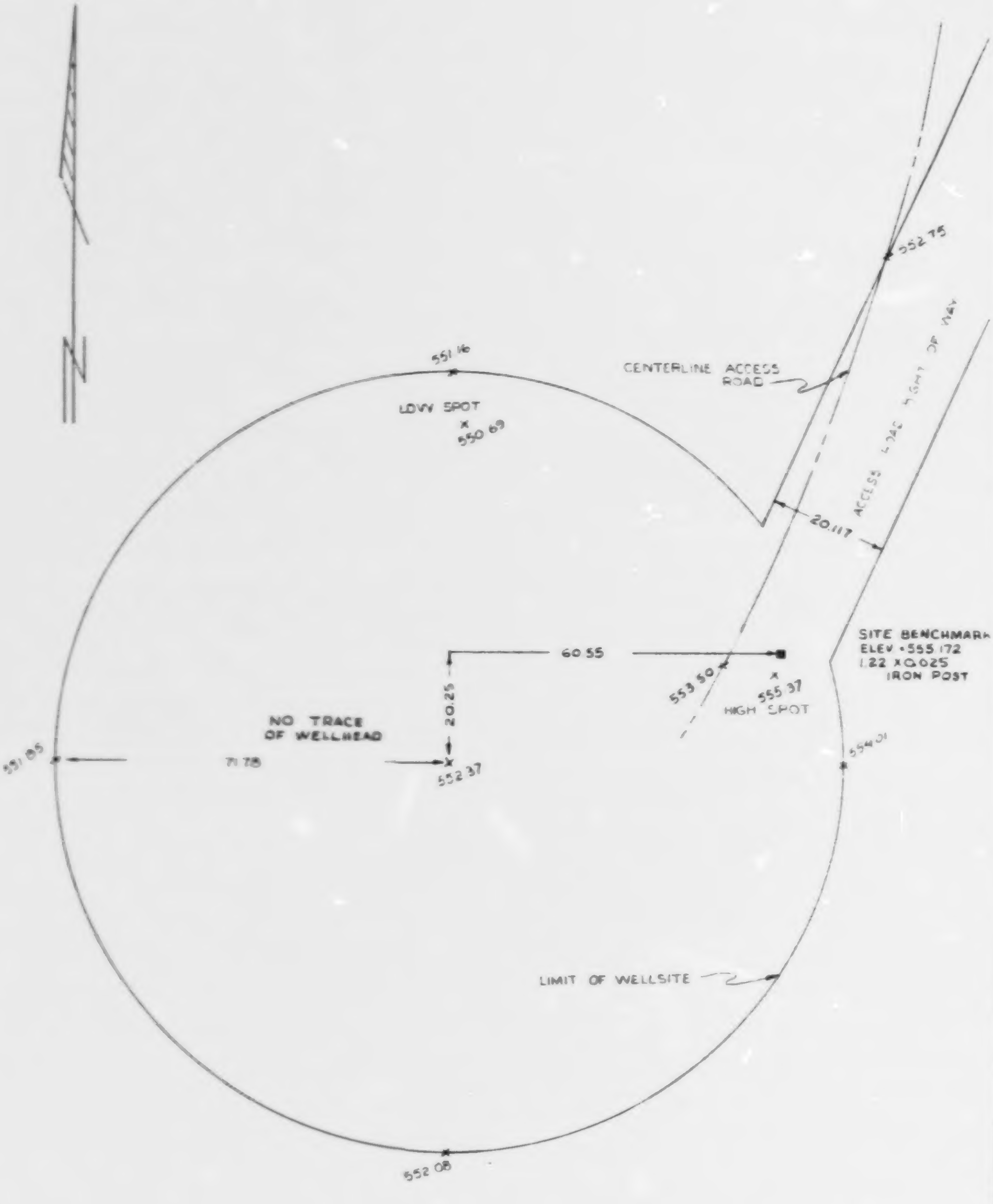
NOTE
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS . . . . ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE SURVEYS LTD.
REGINA, MOOSE JAW

SKETCH PLAN
SHOWING
WELLSITE G.A. WALKER 4-26
LSD 4 -SEC 26- TWP 6 -RGE 13 - W2M

SCALE: 1:500
DATE: NOV. 20, 1986
DRAWN BY: G.A.R.
DRAWING NO.: 2500-22


551.16
LOW SPOT
550.69
CENTERLINE ACCESS ROAD
552.75
ACCESS ROAD RIGHT OF WAY
20.117
60.55
20.25
NO TRACE OF WELLHEAD
553.50
555.37
HIGH SPOT
SITE BENCHMARK
ELEV. 555.172
1.22 X 0.025
IRON POST
551.85
71.78
552.37
554.01
LIMIT OF WELLSITE
552.08

NOTE

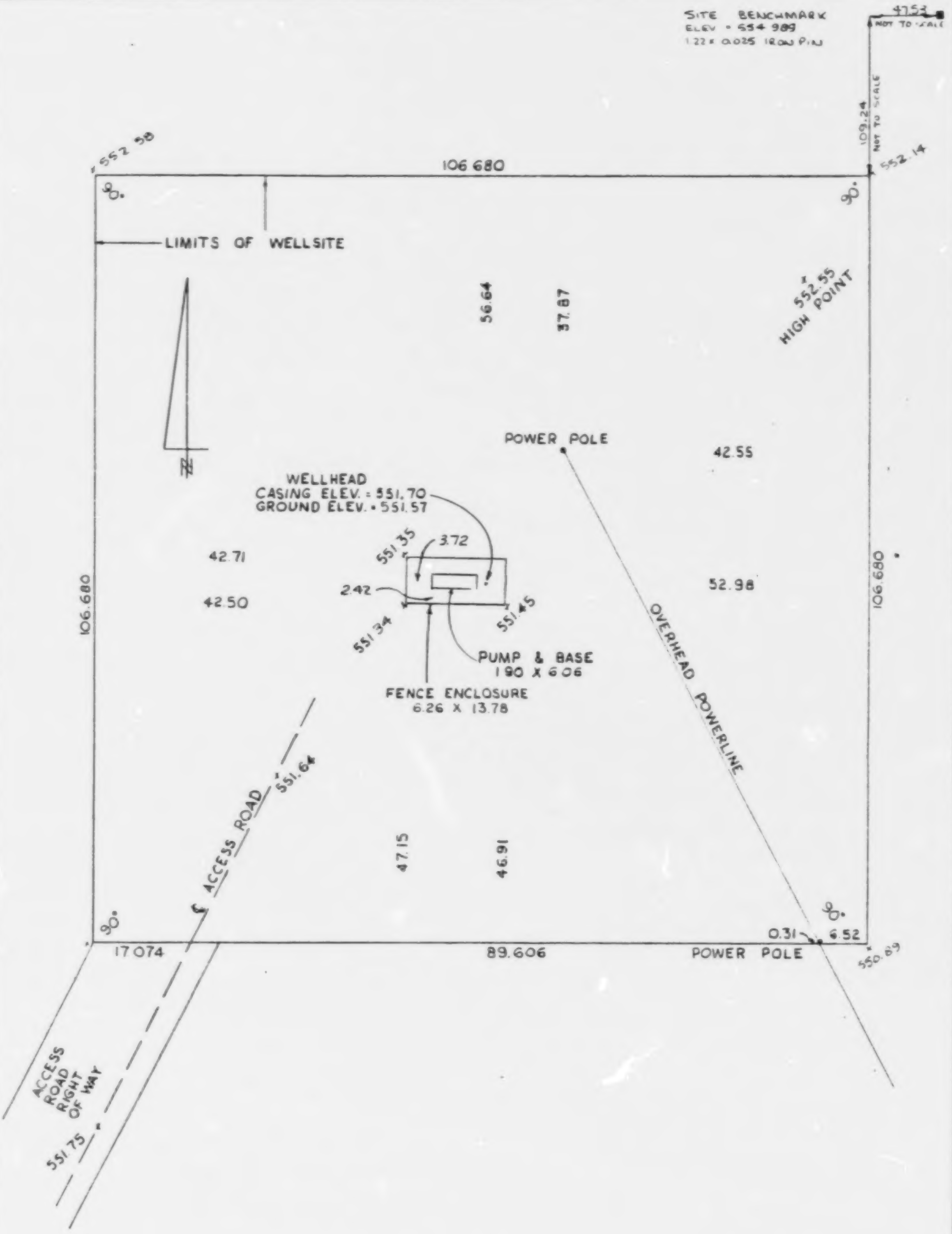
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.

SITE BENCHMARKS ARE SHOWN THUS.... ■

ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE SURVEYS LTD. REGINA, MOOSE JAW	SKETCH PLAN SHOWING WELLSITE IMPERIAL ROUGH BARK WELL NO. 14-25-6-13 LSD 14 - SEC 25 - TWP 6 - RGE 13 - W2M	SCALE: 1:750 DATE: DEC 17, 1986 DRAWN BY: JVZ DRAWING NO.: 2500-23


SITE BENCHMARK
ELEV = 554 989
1.22 x 0.025 IRON PIN
4753
NOT TO SCALE
109.24
NOT TO SCALE
552.58
106 680
552.14
90°
90°
LIMITS OF WELLSITE
56.64
37.87
552.55
HIGH POINT
N
POWER POLE
42.55
WELLHEAD
CASING ELEV. = 551.70
GROUND ELEV. = 551.57
551.35
3.72
42.71
106.680
42.50
2.42
551.34
551.45
52.98
106.680
PUMP & BASE
1.90 X 6.06
FENCE ENCLOSURE
6.26 X 13.78
OVERHEAD POWERLINE
551.64
℄ ACCESS ROAD
47.15
46.91
90°
90°
0.31
6.52
17 074
89.606
POWER POLE
550.89
ACCESS ROAD RIGHT OF WAY
551.75

NOTE

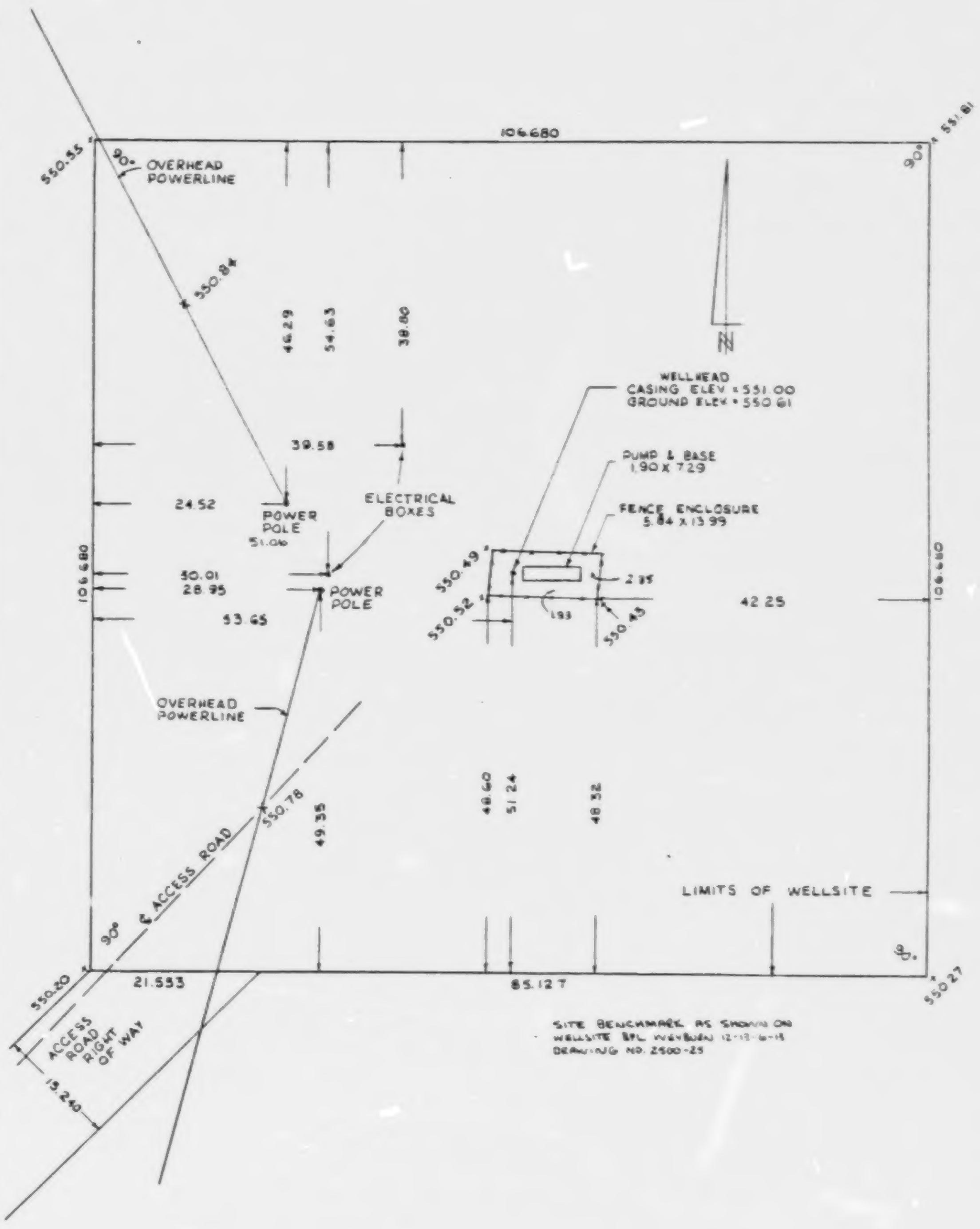
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS . . . .
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE SURVEYS LTD.
REGINA, MOOSE JAW

SKETCH PLAN
SHOWING
WELLSITE
MURPHY
BRALORNE WEYBURN
4-24-6-13
LSD 4 - SEC24 - TWP 6 - RGE 13 - W2M

SCALE: 1:500
DATE: NOV 21, 1986
DRAWN BY: G.A.R.
DRAWING NO.: 2500-24


106.680
550.55
90°
OVERHEAD POWERLINE
551.81
90°
550.84
46.29
54.63
38.80
39.58
24.52
POWER POLE
51.06
ELECTRICAL BOXES
30.01
28.95
53.65
POWER POLE
106.680
WELLHEAD
CASING ELEV = 551.00
GROUND ELEV = 550.61
PUMP & BASE
1.90 X 7.29
FENCE ENCLOSURE
5.84 X 13.99
550.49
550.52
2.35
1.93
550.45
42.25
106.680
OVERHEAD POWERLINE
550.78
49.35
48.60
51.24
48.32
℄ ACCESS ROAD
90°
LIMITS OF WELLSITE
90°
550.20
21.553
85.127
550.27
ACCESS ROAD RIGHT OF WAY
15.240
N

SITE BENCHMARK AS SHOWN ON
WELLSITE BPL WEYBURN 12-13-6-13
DRAWING NO. 2500-25

NOTE

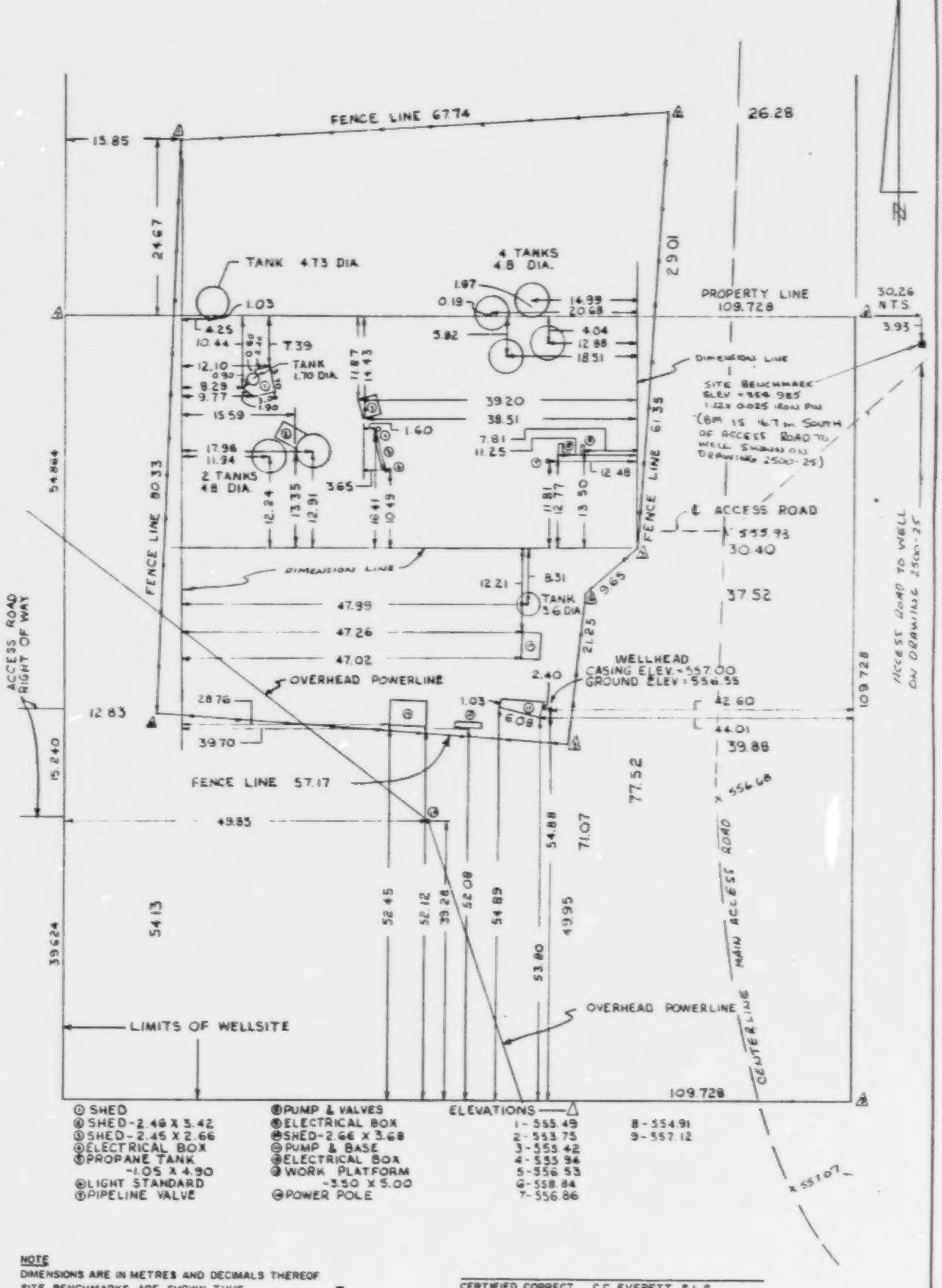
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS . . . ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE SURVEYS LTD.
REGINA, MOOSE JAW

SKETCH PLAN
SHOWING
WELLSITE
MURPHY
BRALORNE WEYBURN
14-13-6-13
LSD 14 - SEC 13 - TWP 6 - RGE 13 - W2M

SCALE: 1:500
DATE: NOV 25, 1986
DRAWN BY: G.A.B.
DRAWING NO.: 2500-25


FENCE LINE 67.74
26.28
15.85
24.67
29.01
TANK 4.73 DIA.
4 TANKS
4.8 DIA.
1.87
0.19
14.99
20.68
5.82
4.04
12.88
18.51
1.03
4.25
10.44
7.39
12.10
TANK
1.70 DIA.
8.29
9.77
15.59
11.87
14.43
39.20
38.51
1.60
7.81
11.25
12.48
PROPERTY LINE
109.728
30.26
N.T.S.
3.93
DIMENSION LINE
SITE BENCHMARK
ELEV = 554.985
1.22 x 0.025 IRON PIN
(BM IS 16.7 m SOUTH OF ACCESS ROAD TO WELL SHOWN ON DRAWING 2500-25)
17.96
11.94
2 TANKS
4.8 DIA.
3.65
12.24
13.35
12.91
16.41
10.49
11.81
12.77
13.50
FENCE LINE 61.35
℄ ACCESS ROAD
555.93
30.40
54.864
FENCE LINE 80.33
DIMENSION LINE
12.21
8.31
TANK
3.6 DIA
47.99
47.26
47.02
9.65
21.25
37.52
ACCESS ROAD RIGHT OF WAY
WELLHEAD
CASING ELEV. = 557.00
GROUND ELEV. = 556.55
2.40
OVERHEAD POWERLINE
28.76
1.03
6.08
42.60
44.01
109.728
12.83
39.70
39.88
ACCESS ROAD TO WELL ON DRAWING 2500-25
FENCE LINE 57.17
15.240
49.85
77.52
556.68
54.88
71.07
MAIN ACCESS ROAD
54.13
39.624
52.45
52.12
39.28
52.08
54.89
53.80
49.95
OVERHEAD POWERLINE
CENTERLINE
LIMITS OF WELLSITE
109.728
N
55107

① SHED
② SHED - 2.48 X 3.42
③ SHED - 2.45 X 2.66
④ ELECTRICAL BOX
⑤ PROPANE TANK - 1.05 X 4.90
⑥ LIGHT STANDARD
⑦ PIPELINE VALVE
⑧ PUMP & VALVES
⑨ ELECTRICAL BOX
⑩ SHED - 2.66 X 3.68
⑪ PUMP & BASE
⑫ ELECTRICAL BOX
⑬ WORK PLATFORM - 3.50 X 5.00
⑭ POWER POLE

ELEVATIONS —— △

1 - 555.49
2 - 553.75
3 - 555.42
4 - 555.94
5 - 556.53
6 - 558.84
7 - 556.86
8 - 554.91
9 - 557.12

NOTE

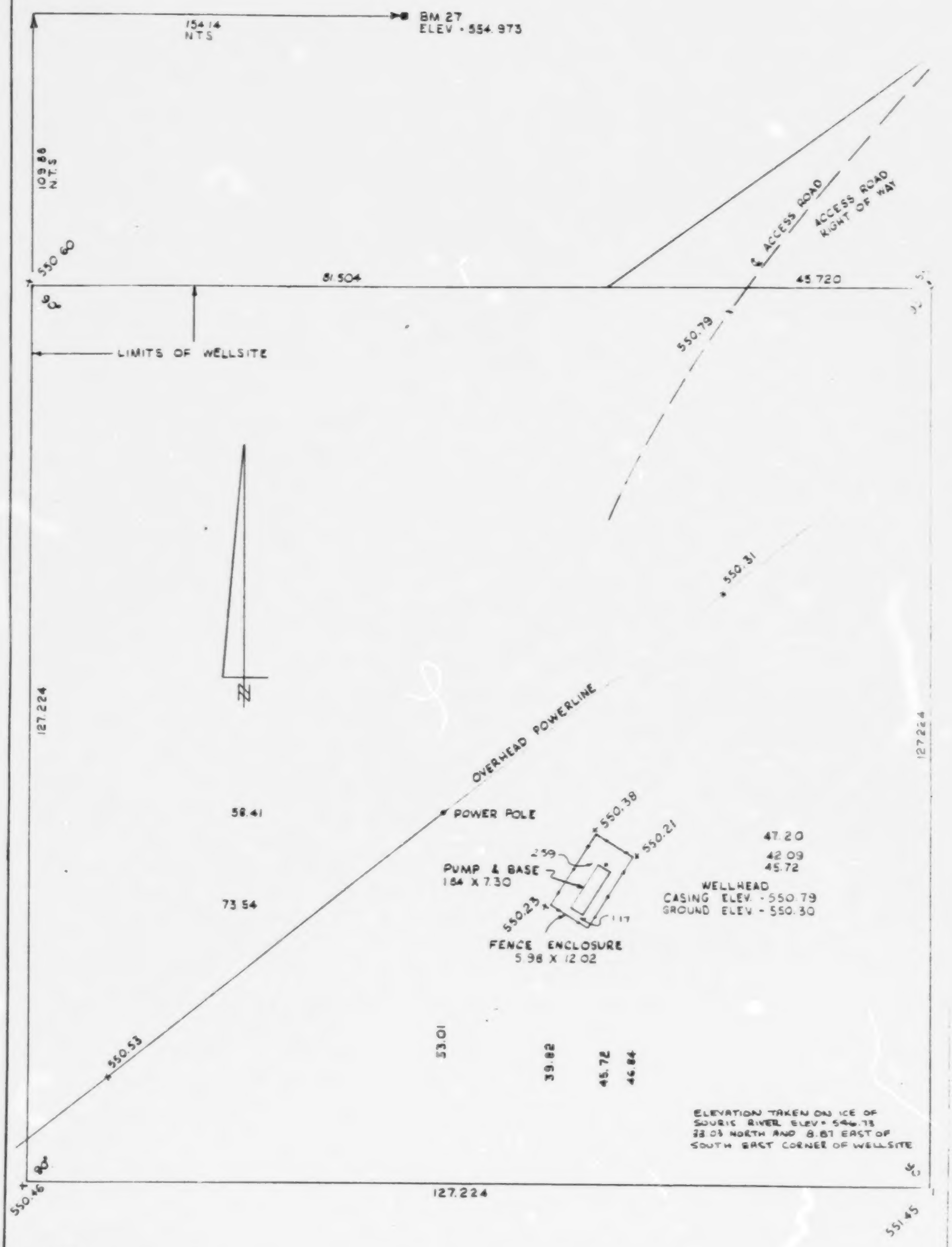
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS .... ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE SURVEYS LTD.
REGINA, MOOSE JAW

SKETCH PLAN MURPHY BATTERY
SHOWING
WELLSITE BPL WEYBURN 12-13-6-13
LSD 12 - SEC 13 - TWP 6 - RGE 13 - W2M

SCALE: 1:500
DATE: NOV. 12, 1986
DRAWN BY: G.A.R.
DRAWING NO.: 2900-26


BM 27
ELEV - 554.973
154.14
NTS
109.88
N.T.S
550.60
81.504
45.720
LIMITS OF WELLSITE
℄ ACCESS ROAD
ACCESS ROAD
RIGHT OF WAY
550.79
550.31
N
127.224
127.224
OVERHEAD POWERLINE
POWER POLE
58.41
73.54
550.38
550.21
2.59
PUMP & BASE
1.84 X 7.30
550.23
1.17
FENCE ENCLOSURE
5.98 X 12.02
47.20
42.09
45.72
WELLHEAD
CASING ELEV. - 550.79
GROUND ELEV. - 550.30
53.01
39.82
45.72
46.84
550.53
550.46
127.224
551.45
ELEVATION TAKEN ON ICE OF
SOURIS RIVER ELEV = 546.73
33.03 NORTH AND 8.87 EAST OF
SOUTH EAST CORNER OF WELLSITE

NOTE

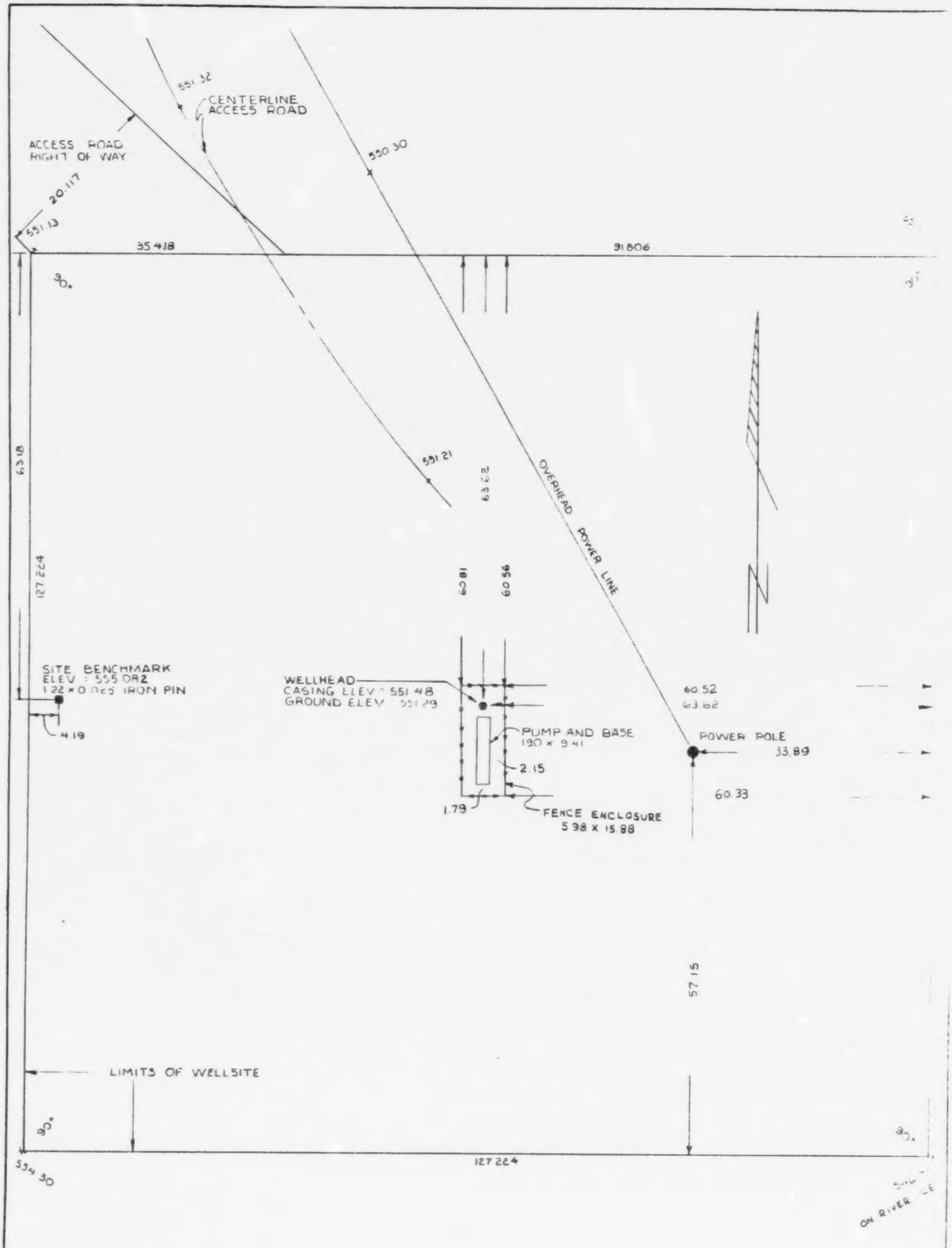
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS .... ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE
SURVEYS LTD.
REGINA, MOOSE JAW

SKETCH PLAN
SHOWING
WELLSITE
PANCANADIAN UNIT
CENTRAL DEL RIO
SOUTH RALPH 10-13
LSD10 -SEC 13-TWP 6 -RGE 13 -W2M

SCALE: 1:500
DATE: NOV. 24, 1986
DRAWN BY: G.A.R.
DRAWING NO.: 2500-27


551.32
CENTERLINE ACCESS ROAD
ACCESS ROAD RIGHT OF WAY
550.30
20.117
551.13
35.418
91.806
90°
90°
551.21
63.62
OVERHEAD POWER LINE
63.18
127.224
60.81
60.56
SITE BENCHMARK
ELEV = 555.082
1.22 × 0.025 IRON PIN
4.19
WELLHEAD
CASING ELEV = 551.48
GROUND ELEV = 551.29
PUMP AND BASE
1.90 × 9.41
2.15
1.79
FENCE ENCLOSURE
5.98 × 15.88
60.52
63.62
POWER POLE
33.89
60.33
57.15
LIMITS OF WELLSITE
90°
90°
127.224
554.30
ON RIVER

NOTE

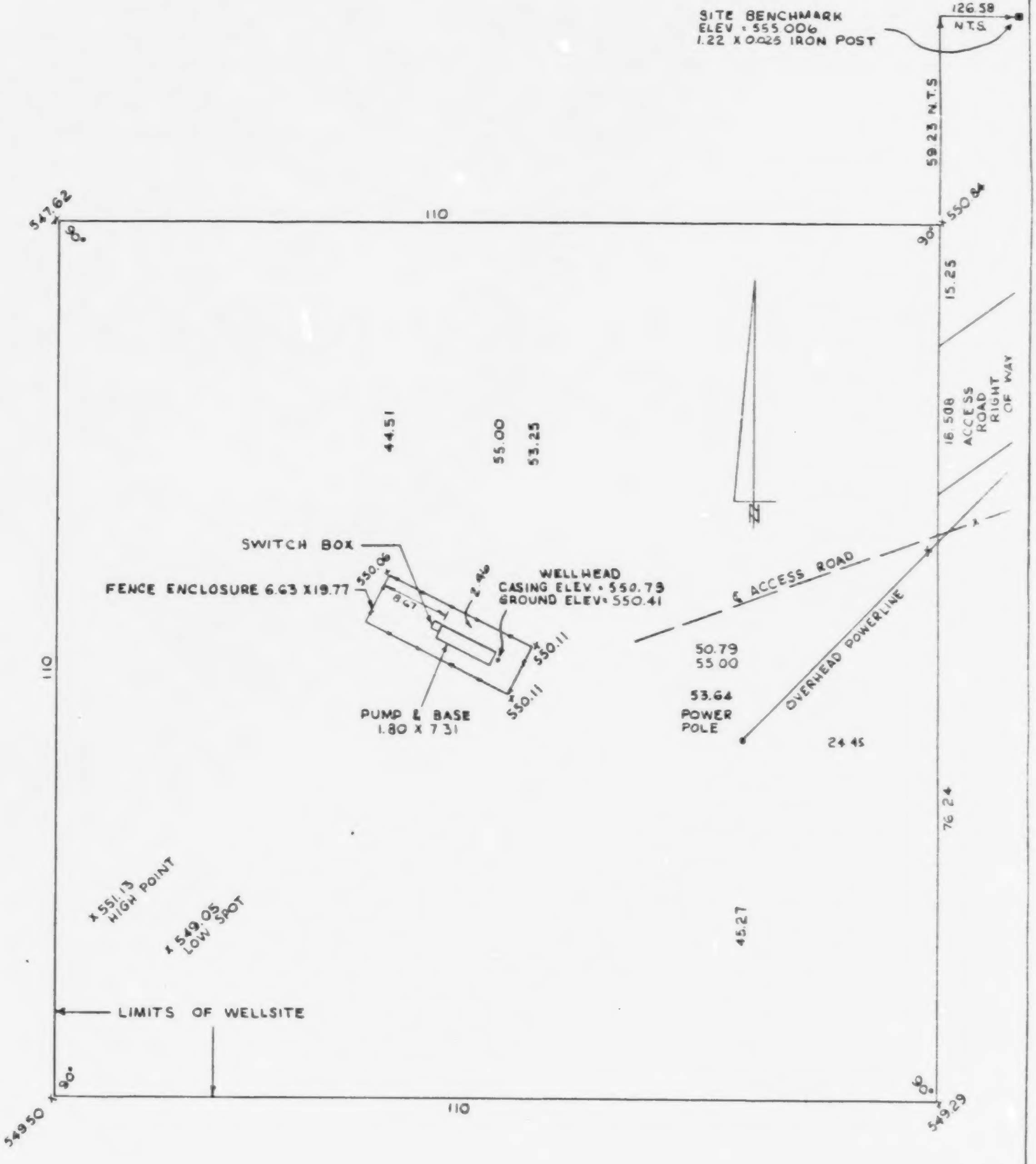
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS .... ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE SURVEYS. LTD.
REGINA, MOOSE JAW

SKETCH PLAN
SHOWING
WELLSITE MURPHY WEYBURN 7-13-6-13
LSD 7 - SEC 13 - TWP 6 - RGE 13 - W2M

SCALE: 1:500
DATE: DEC 18, 1986
DRAWN BY: JVZ
DRAWING NO.: 2500-38


SITE BENCHMARK
ELEV = 555.006
1.22 X 0.025 IRON POST
126.58
N.T.S.
59.23 N.T.S.
547.62
90°
110
90°
550.84
15.25
16.508
ACCESS ROAD RIGHT OF WAY
44.51
55.00
53.25
N
SWITCH BOX
FENCE ENCLOSURE 6.63 X 19.77
550.06
8.67
2.40
WELLHEAD
CASING ELEV = 550.79
GROUND ELEV = 550.41
550.11
550.11
PUMP & BASE
1.80 X 7.31
℄ ACCESS ROAD
OVERHEAD POWERLINE
50.79
55.00
53.64
POWER POLE
24.45
110
76.24
x 551.13 HIGH POINT
x 549.05 LOW SPOT
45.27
LIMITS OF WELLSITE
90°
549.50
110
90°
549.29

NOTE

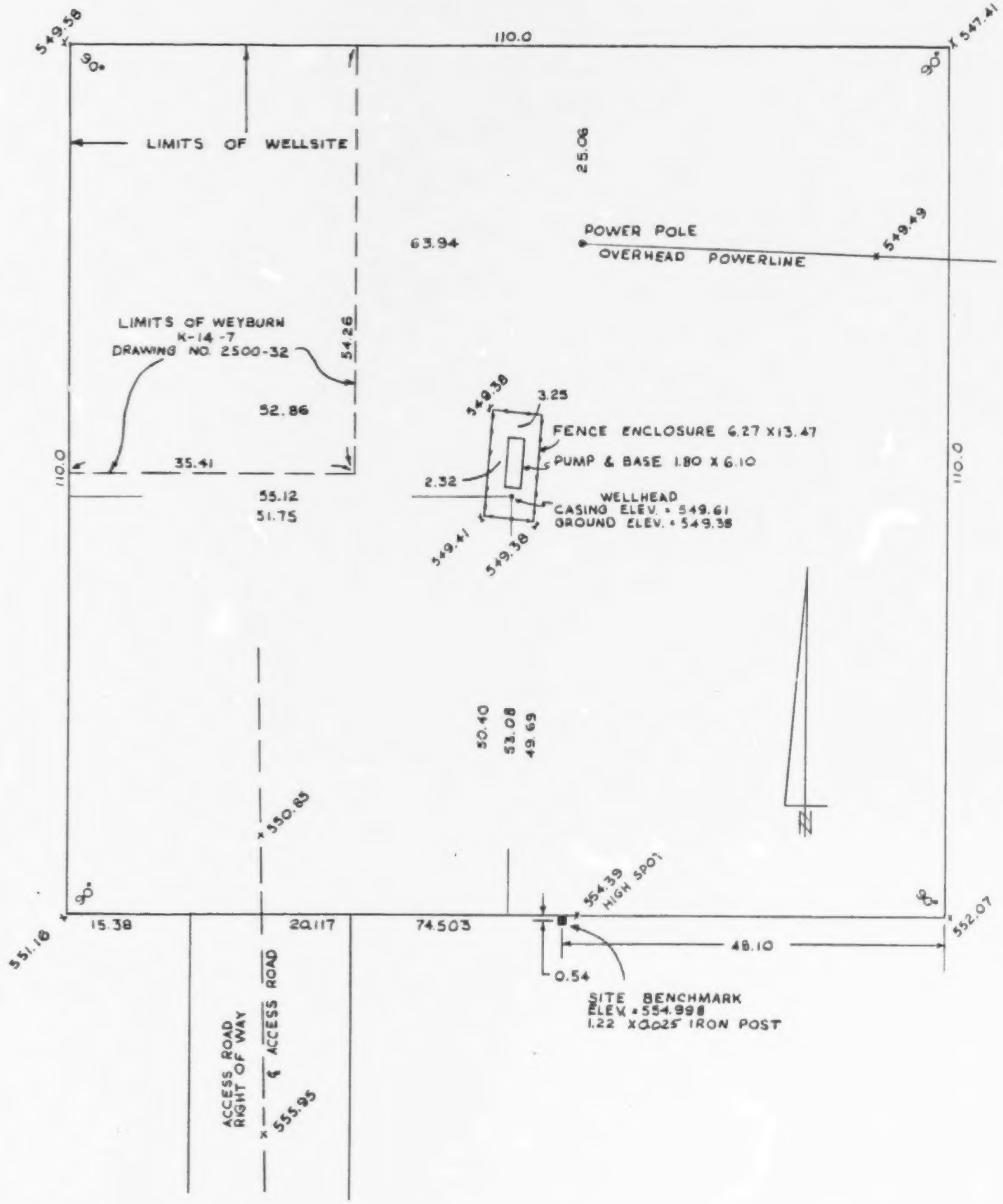
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS .... ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE SURVEYS LTD.
REGINA, MOOSE JAW

SKETCH PLAN
SHOWING
WELLSITE TRI LINK LOMALTA WEYBURN 4-18-6-12
LSD 4 - SEC 18 - TWP 6 - RGE 12 - W2M

SCALE: 1:500
DATE: NOV. 24, 1986
DRAWN BY: G.A.R.
DRAWING NO.: 2500-30


549.58
110.0
547.41
90°
90°
LIMITS OF WELLSITE
25.08
POWER POLE
OVERHEAD POWERLINE
549.49
63.94
LIMITS OF WEYBURN
K-14-7
DRAWING NO. 2500-32
54.26
52.86
549.38
3.25
FENCE ENCLOSURE 6.27 X 13.47
PUMP & BASE 1.80 X 6.10
2.32
WELLHEAD
CASING ELEV. = 549.61
GROUND ELEV. = 549.38
549.41
549.38
110.0
35.41
55.12
51.75
110.0
50.40
53.08
49.69
N
550.85
554.39
HIGH SPOT
90°
90°
551.16
15.38
20.117
74.503
552.07
48.10
0.54
SITE BENCHMARK
ELEV. = 554.998
1.22 X 0.025 IRON POST
ACCESS ROAD
RIGHT OF WAY
℄ ACCESS ROAD
555.95

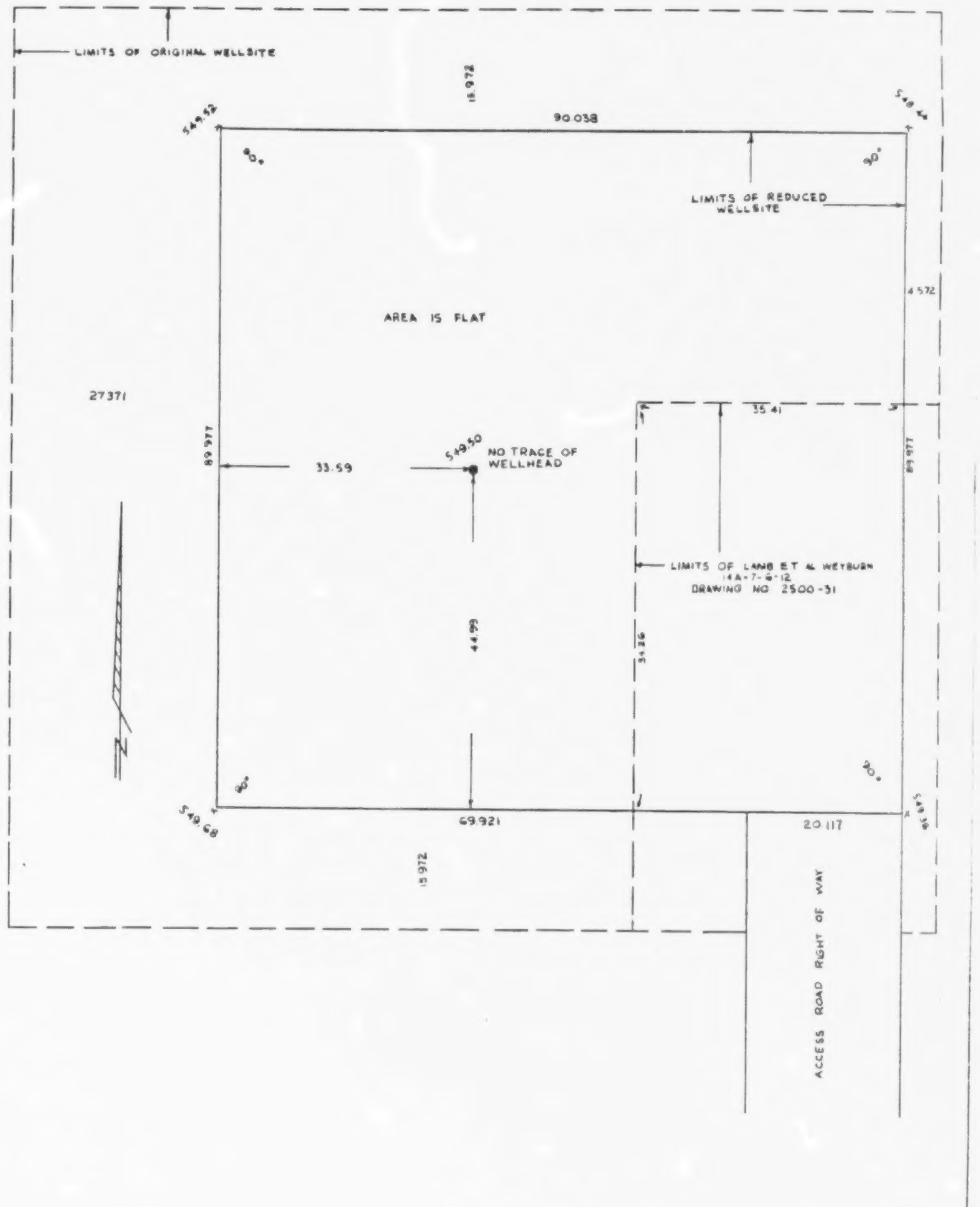
NOTE

DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS .... ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE SURVEYS LTD. REGINA, MOOSE JAW	SKETCH PLAN SHOWING CAPRICE WELLSITE LAMB ET AL WEYBURN 14A-7-6-12 LSD 14 - SEC 7 - TWP 6 - RGE 12 - W2M	SCALE: 1:500 DATE: NOV. 25, 1986 DRAWN BY: G.A.R DRAWING NO.: 2500-31

SITE BENCHMARK AS SHOWN ON
LAMB ET AL WEYBURN 14A-7-6-12
DRAWING NO 2500-31


LIMITS OF ORIGINAL WELLSITE
15.972
549.52
90.038
549.44
90°
90°
LIMITS OF REDUCED WELLSITE
4.572
AREA IS FLAT
27.371
35.41
89.977
33.59
549.50
NO TRACE OF WELLHEAD
89.977
LIMITS OF LAMB ET AL WEYBURN 14A-7-6-12 DRAWING NO 2500-31
44.99
34.26
90°
90°
549.68
69.921
20.117
549.36
15.972
ACCESS ROAD RIGHT OF WAY

NOTE

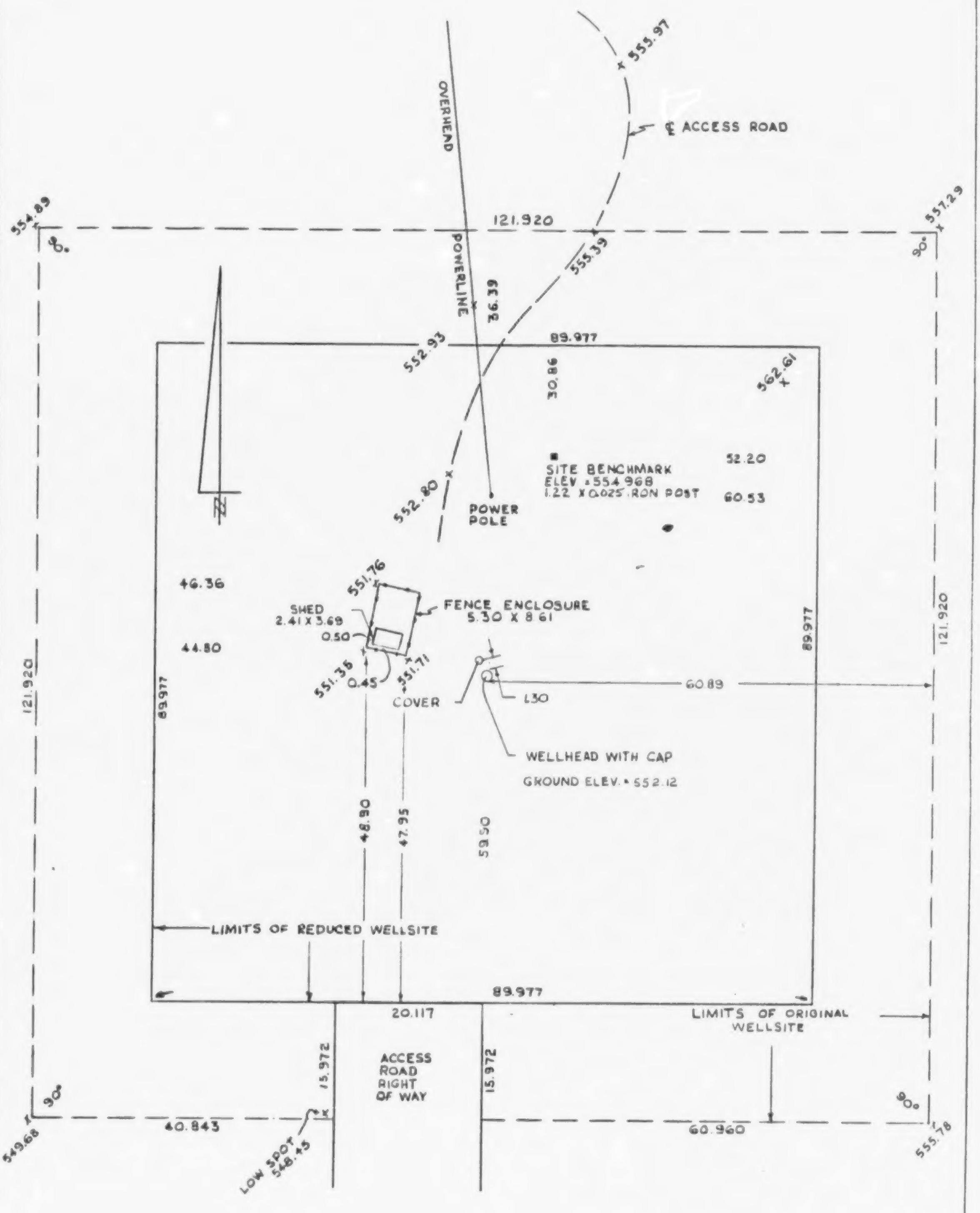
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS .... ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT , C.C. EVERETT S.L.S.

PRAIRIE SURVEYS LTD.
REGINA, MOOSE JAW

SKETCH PLAN
SHOWING
WELLSITE WEYBURN K-14-7
LSD/14-SEC 7 -TWP 6 -RGE 12 -W2M

SCALE: 1:500
DATE: DEC 17, 1986
DRAWN BY: JVZ
DRAWING NO.: 2500-32


OVERHEAD
POWERLINE
+ 555.97
℄ ACCESS ROAD
554.89
90°
121.920
557.29
90°
555.39
36.39
552.93
89.977
30.86
562.61
SITE BENCHMARK
ELEV. = 554.968
1.22 X 0.025 IRON POST
52.20
60.53
552.80
POWER POLE
N
46.36
44.80
551.76
SHED
2.41 X 3.69
0.50
FENCE ENCLOSURE
5.30 X 8.61
551.35
0.45
551.71
COVER
1.30
60.89
WELLHEAD WITH CAP
GROUND ELEV. = 552.12
121.920
89.977
89.977
121.920
48.90
47.95
59.50
LIMITS OF REDUCED WELLSITE
89.977
20.117
LIMITS OF ORIGINAL WELLSITE
15.972
ACCESS ROAD RIGHT OF WAY
15.972
90°
549.68
40.843
LOW SPOT 548.45
60.960
90°
555.78

NOTE

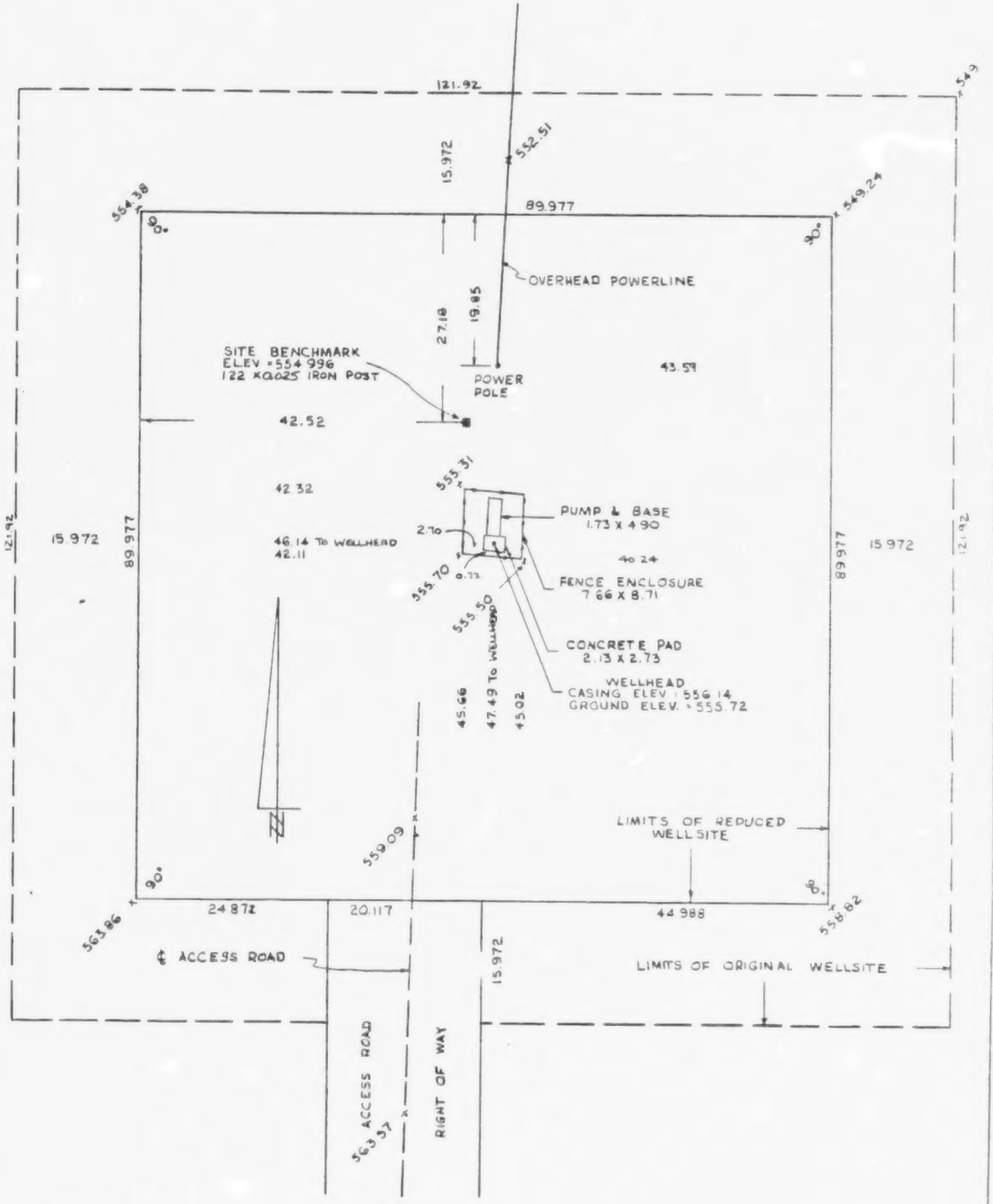
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS .... ■
ELEVATIONS ARE GEODETIC.
ALL DIMENSIONS SHOWN TO ORIGINAL WELLSITE UNLESS OTHERWISE SHOWN

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE SURVEYS LTD.
REGINA, MOOSE JAW

SKETCH PLAN
SHOWING PANCANADIAN UNIT
WELLSITE SHELL OIL COMPANY OF CANADA, LTD. WEYBURN K-16-7
LSD16-SEC7-TWP6-RGE12-W2M

SCALE: 1:500
DATE: NOV. 24, 1986
DRAWN BY: G.A.R.
DRAWING NO.: 2500-32A


121.92
549
15.972
552.51
554.38
90°
89.977
549.24
90°
OVERHEAD POWERLINE
27.18
19.85
SITE BENCHMARK
ELEV =554.996
122 X 0.025 IRON POST
POWER
POLE
43.59
42.52
555.31
42.32
PUMP & BASE
1.73 X 4.90
2.70
46.14 TO WELLHEAD
42.11
40.24
121.92
15.972
89.977
555.70
0.73
FENCE ENCLOSURE
7.66 X 8.71
89.977
15.972
121.92
555.50
CONCRETE PAD
2.13 X 2.73
WELLHEAD
CASING ELEV : 556.14
GROUND ELEV. = 555.72
45.66
47.49 TO WELLHEAD
45.02
N
LIMITS OF REDUCED
WELLSITE
559.09
90°
90°
563.86
24.872
20.117
44.988
558.82
℄ ACCESS ROAD
15.972
LIMITS OF ORIGINAL WELLSITE
ACCESS ROAD
563.57
RIGHT OF WAY

NOTE

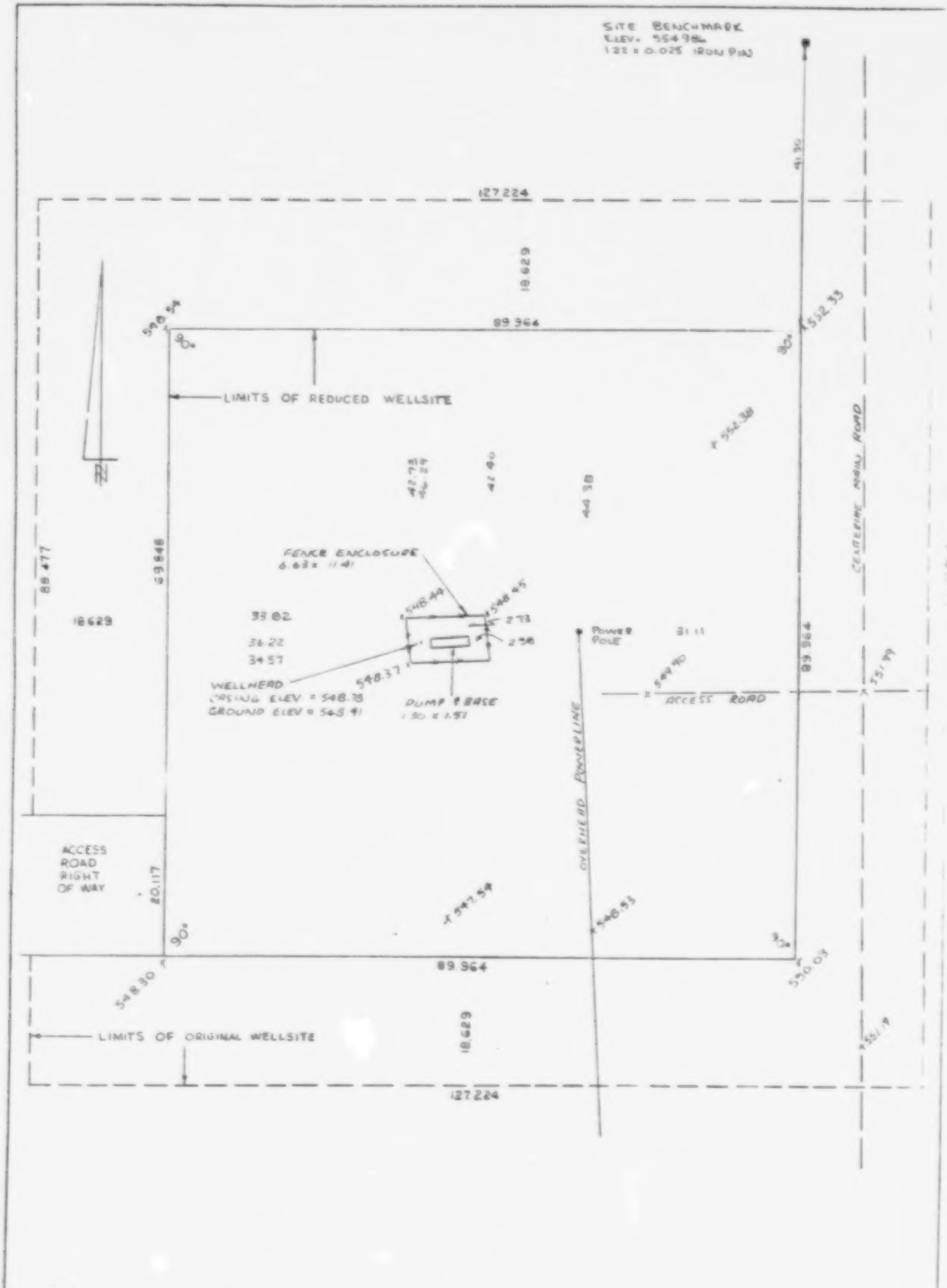
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS.............■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

**PRAIRIE
SURVEYS LTD.**
REGINA, MOOSE JAW

SKETCH PLAN
SHOWING PANCANADIAN UNIT
WELLSITE SHELL OIL COMPANY OF CANADA, LIMITED WEYBURN K-10-7
LSD 10 - SEC 7 - TWP 6 - RGE 12 - W2M

SCALE: 1:500
DATE: NOV. 25, 1986
DRAWN BY: G.A.R.
DRAWING NO.: 2500-33


SITE BENCHMARK
ELEV. 554.98
1.22 x 0.025 IRON PIN
41.30
127.224
18.629
548.54
90°
89.964
90°
552.33
LIMITS OF REDUCED WELLSITE
552.38
N
42.73
42.29
42.40
44.38
CENTERLINE MAIN ROAD
88.477
69.848
18.629
FENCE ENCLOSURE
6.63 x 11.41
548.44
548.45
2.73
2.58
33.82
36.22
34.57
548.37
WELLHEAD
CASING ELEV = 548.78
GROUND ELEV = 548.41
PUMP & BASE
1.90 x 1.51
POWER POLE
31.11
549.90
ACCESS ROAD
89.964
551.94
OVERHEAD POWERLINE
ACCESS ROAD RIGHT OF WAY
80.117
547.54
548.53
90°
90°
548.30
89.964
550.03
18.629
LIMITS OF ORIGINAL WELLSITE
551.9
127.224

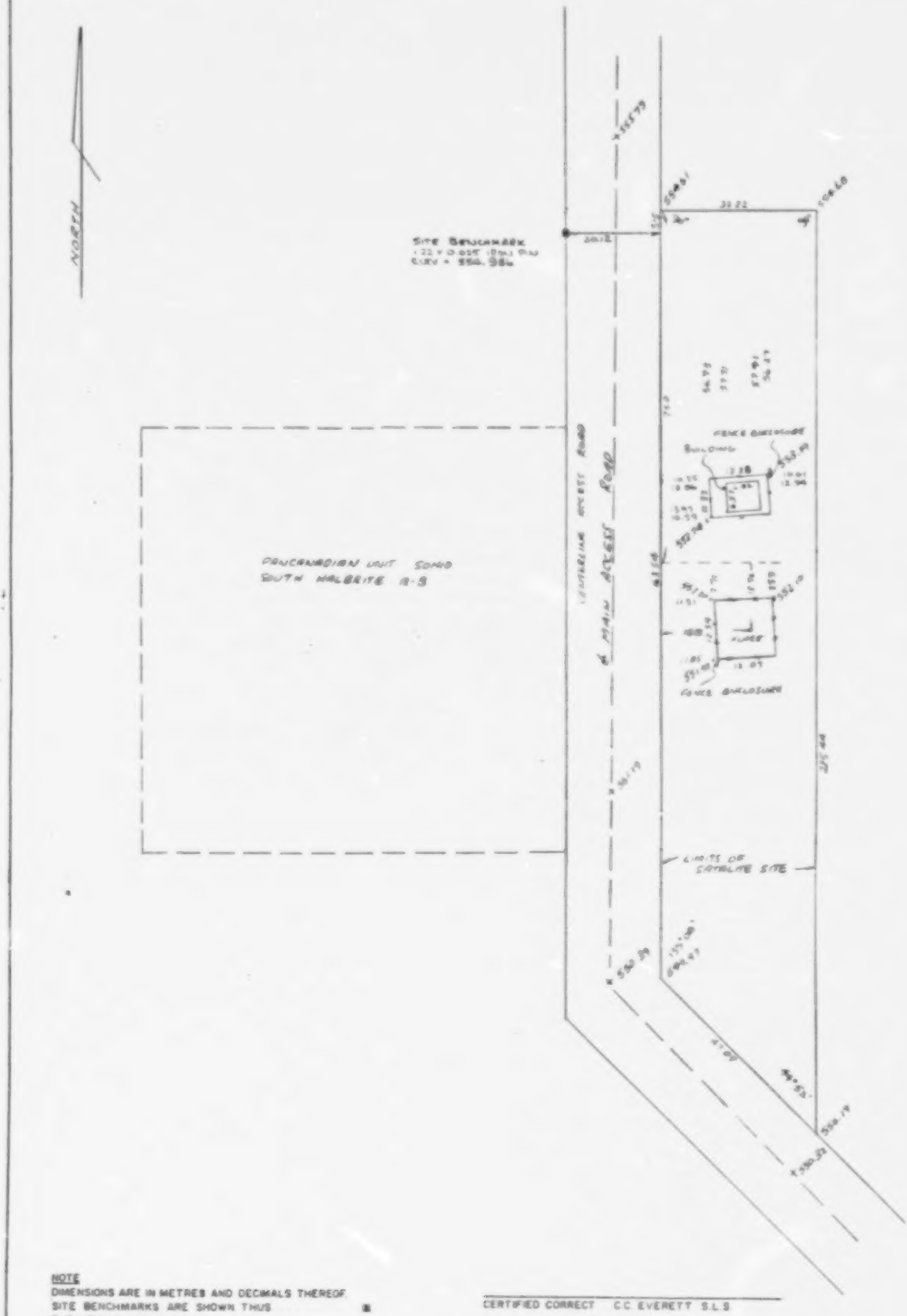
NOTE
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS ... ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE SURVEYS LTD.
REGINA, MOOSE JAW

SKETCH PLAN
SHOWING PANCANADIAN UNIT SOHIO
WELLSITE SOUTH HALBRITE 12-6
LSD 12 - SEC 6 - TWP 6 - RGE 12 - W2M

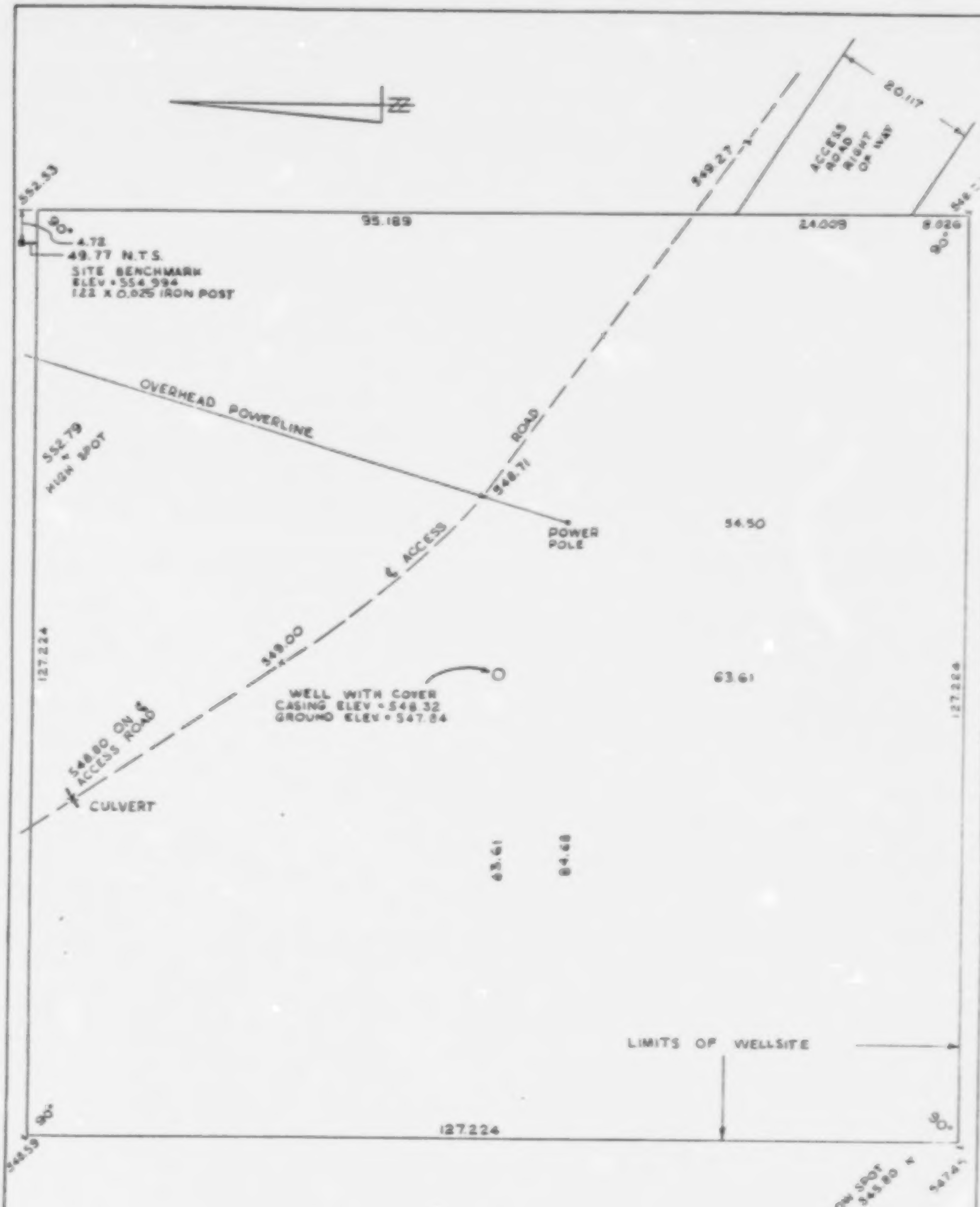
SCALE: 1:500
DATE: NOV. 25, 1988
DRAWN BY: G.A.R.
DRAWING NO.: 2500-34


NORTH
SITE BENCHMARK
ELEV = 554.986
39.22
PANCANADIAN UNIT SOMO
SOUTH HALBRITE A-9
CENTRELINE ACCESS ROAD
MAIN ACCESS ROAD
FENCE ENCLOSURE
BUILDING
FLARE
FENCE ENCLOSURE
LIMITS OF SATELLITE SITE
225.44

NOTE
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

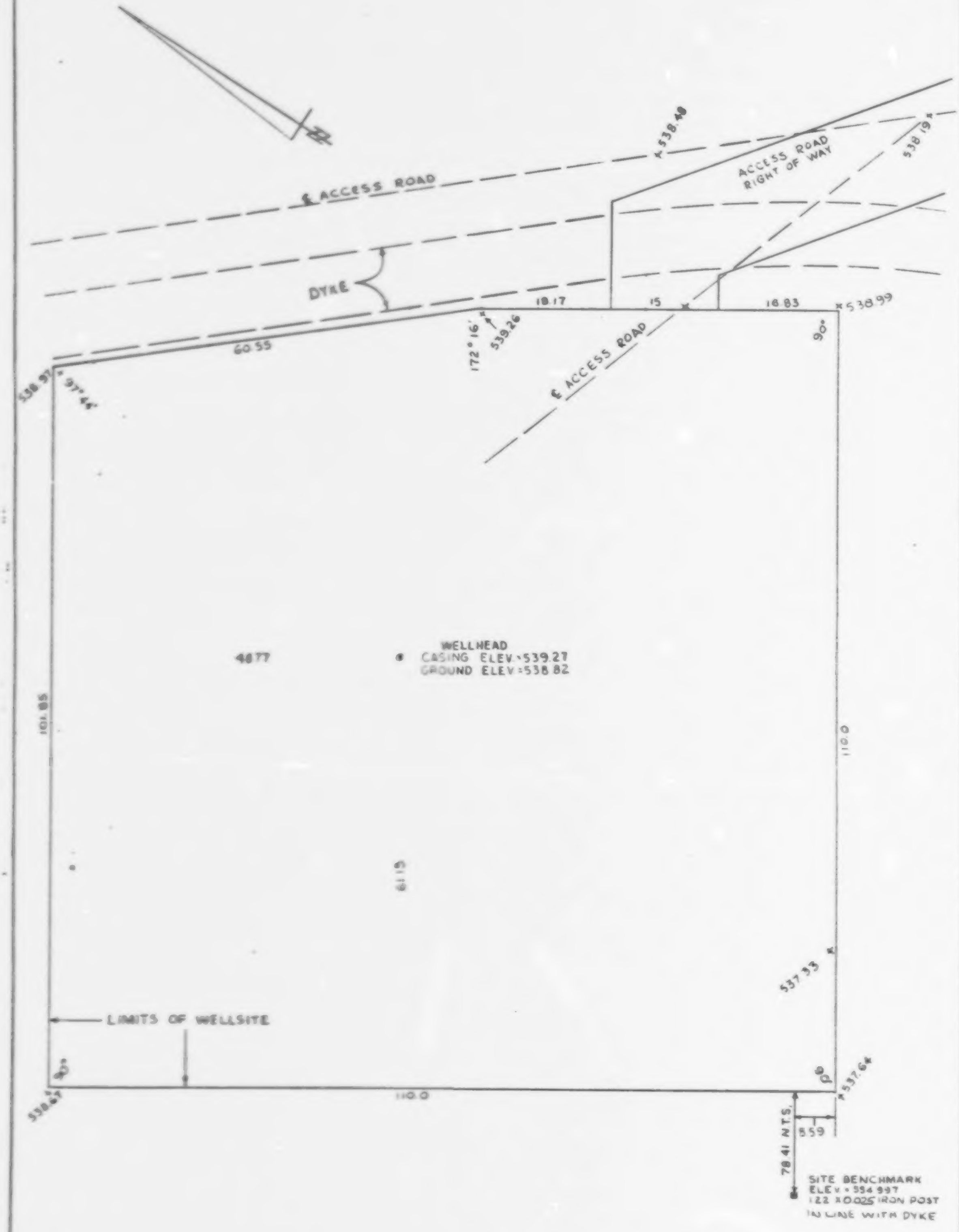
PRAIRIE SURVEYS LTD. REGINA, MOOSE JAW	SKETCH PLAN SHOWING WELLSITE PCP WEYBURN UNIT SATELLITE STATION STG. LSD 12-SEC 8 -TWP 6 -RGE 13 -W2M	SCALE: 1:750 DATE: DRAWN BY: C.A.B. DRAWING NO.: 2500-34A


N
552.53
90°
4.72
49.77 N.T.S.
SITE BENCHMARK
ELEV = 554.994
1.22 X 0.025 IRON POST
95.189
549.27
ACCESS ROAD RIGHT OF WAY
20.117
24.009
8.026
90°
OVERHEAD POWERLINE
552.79
HIGH SPOT
ROAD
548.71
℄ ACCESS
POWER POLE
54.50
127.224
549.00
WELL WITH COVER
CASING ELEV = 548.32
GROUND ELEV = 547.84
63.61
127.224
548.80 ON ℄ ACCESS ROAD
CULVERT
63.61
64.48
LIMITS OF WELLSITE
90°
127.224
90°
548.59
LOW SPOT
545.80
547.4

NOTE
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS .... ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE SURVEYS LTD. REGINA, MOOSE JAW	SKETCH PLAN SHOWING WELLSITE HUDSON'S BAY WEYBURN 6-8 LSD 6 -SEC 8 -TWP 6 -RGE 12 -W2M	SCALE: 1:500 DATE: NOV. 26, 1984 DRAWN BY: G.A.R. DRAWING NO.: 2500-38



N
℄ ACCESS ROAD
× 538.48
ACCESS ROAD
RIGHT OF WAY
538.19 ×
DYKE
18.17
15
16.83
× 538.99
60.55
172° 16'
× 539.26
90°
℄ ACCESS ROAD
538.57 ×
97° 44'
WELLHEAD
CASING ELEV.=539.27
GROUND ELEV.=538.82
48.77
101.85
110.0
61.15
537.33 ×
LIMITS OF WELLSITE
90°
538.47 ×
110.0
90°
× 537.64
78.41 N.T.S.
5.59
SITE BENCHMARK
ELEV.=534.997
1.22 × 0.025 IRON POST
IN LINE WITH DYKE

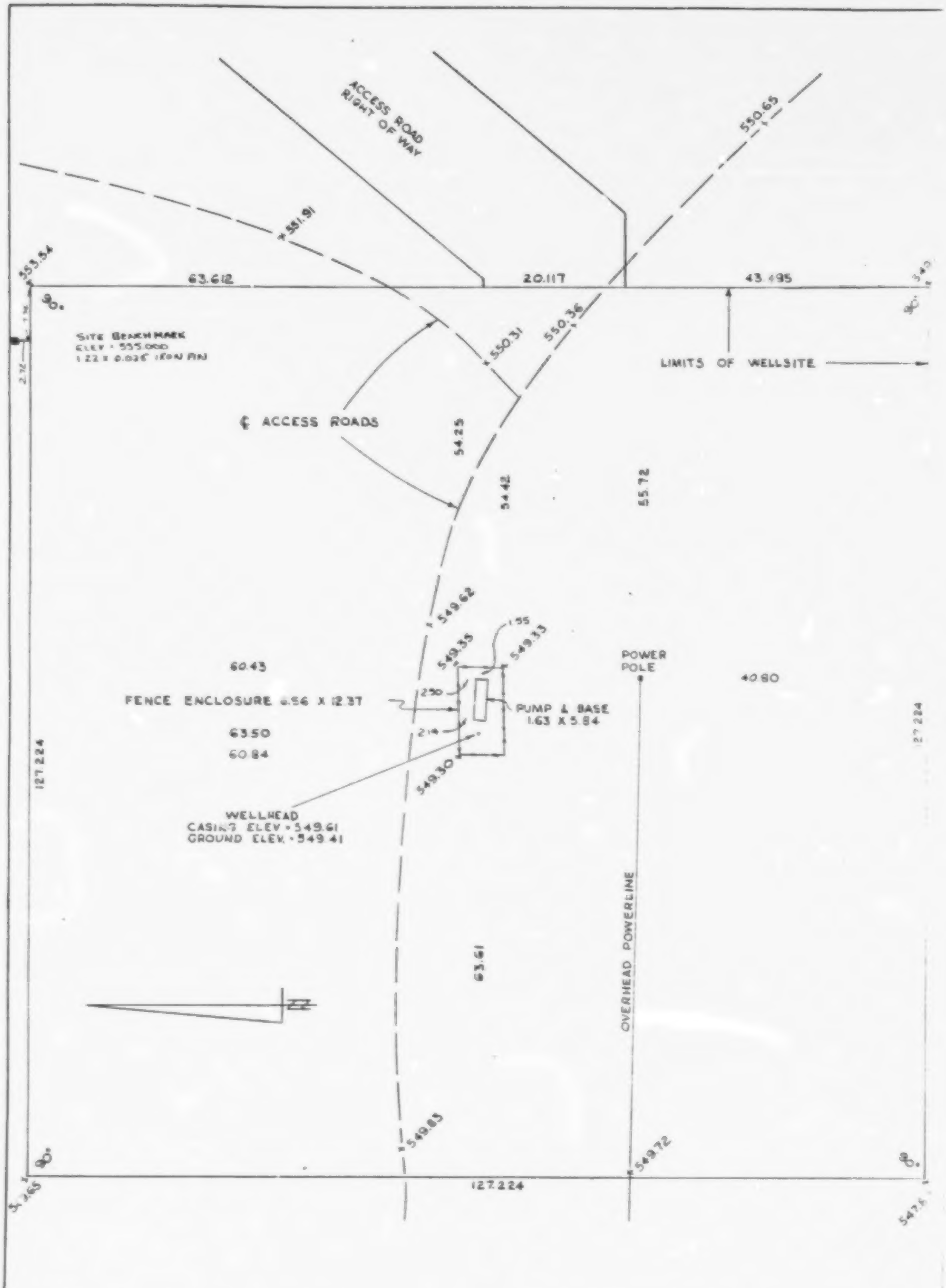
NOTE
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS.............. ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE SURVEYS LTD.
REGINA, MOOSE JAW

SKETCH PLAN
SHOWING
WELLSITE SASKOIL OUTRAM 9-35-3-11
LSD 9 - SEC 35 - TWP 3 - RGE 11 - W2M

SCALE: 1:500
DATE: DEC. 4, 1986
DRAWN BY: G.A.R.
DRAWING NO.: 2300-36


ACCESS ROAD
RIGHT OF WAY
550.65
551.91
553.54
63.612
20.117
43.495
90°
SITE BENCHMARK
ELEV = 555.000
1.22 x 0.025 IRON PIN
2.72
550.31
550.36
LIMITS OF WELLSITE
℄ ACCESS ROADS
54.25
54.42
55.72
549.62
1.55
549.35
549.33
POWER POLE
40.80
60.43
FENCE ENCLOSURE 6.56 X 12.37
2.50
PUMP & BASE
1.63 X 5.84
2.14
63.50
60.84
549.30
127.224
WELLHEAD
CASING ELEV = 549.61
GROUND ELEV. = 549.41
OVERHEAD POWERLINE
63.61
549.83
549.72
547.6

NOTE

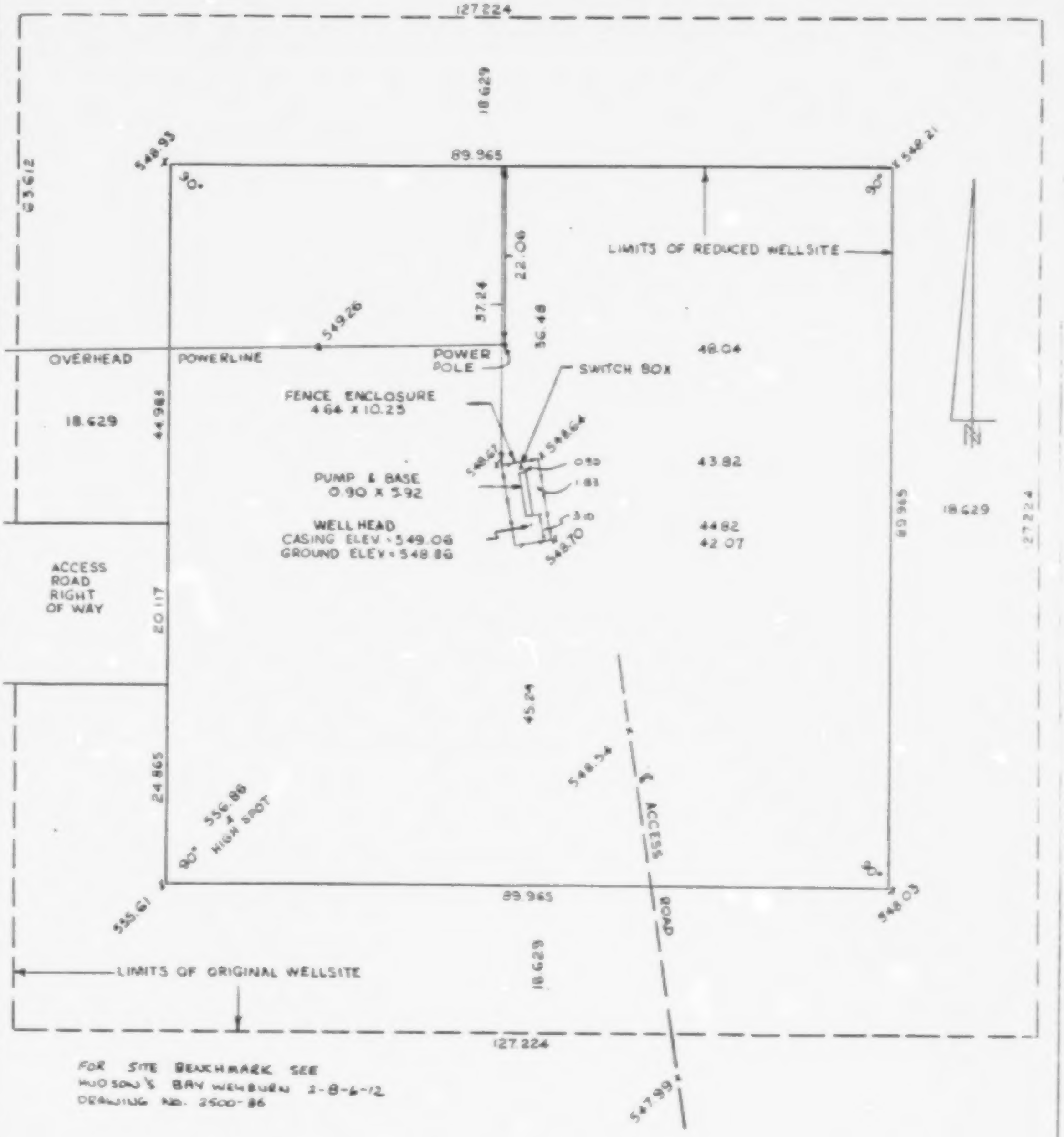
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS .... ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C C EVERETT S.L.S.

PRAIRIE SURVEYS LTD.
REGINA, MOOSE JAW

SKETCH PLAN
SHOWING PANCANADIAN UNIT HUDSON'S BAY
WELLSITE WEYBURN 2-8-6-13
LSD 2 - SEC 8 - TWP 6 - RGE 13 - W2M

SCALE: 1:500
DATE: NOV. 26, 1986
DRAWN BY: G.A.R.
DRAWING NO.: 2500-36


127.224
18.629
63.612
548.93
89.965
90°
x 548.21
22.06
37.24
36.48
LIMITS OF REDUCED WELLSITE
549.26
OVERHEAD
POWERLINE
POWER POLE
48.04
SWITCH BOX
FENCE ENCLOSURE 4.64 x 10.25
18.629
44.985
548.67
548.64
0.90
1.83
43.82
PUMP & BASE 0.90 x 5.92
3.10
WELL HEAD
CASING ELEV. = 549.06
GROUND ELEV. = 548.86
548.70
44.82
42.07
89.965
18.629
127.224
ACCESS ROAD RIGHT OF WAY
20.117
45.24
548.54
℄ ACCESS ROAD
24.865
556.86 x HIGH SPOT
90°
555.61
89.965
548.03
LIMITS OF ORIGINAL WELLSITE
18.629
127.224
547.99
N

FOR SITE BENCHMARK SEE
HUDSON'S BAY WEYBURN 2-8-6-12
DRAWING NO. 2500-86

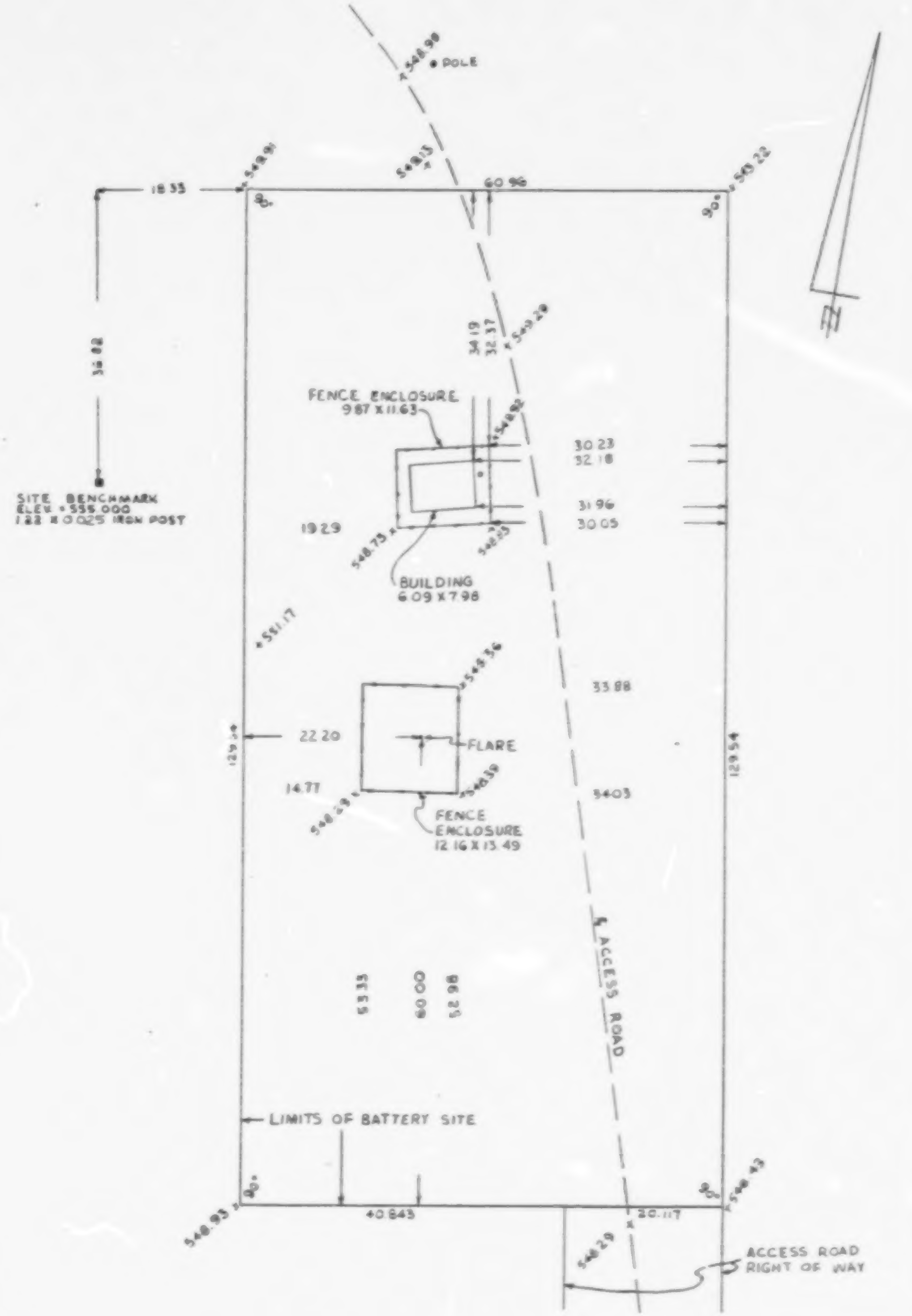
NOTE
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS . . . . ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE
SURVEYS LTD.
REGINA, MOOSE JAW

SKETCH PLAN
SHOWING ~~SOHIO~~ PANCANADIAN UNIT
WELLSITE SOUTH HALBRITE 10-5
LSD 10 - SEC 5 - TWP 6 - RGE 12 - W2M

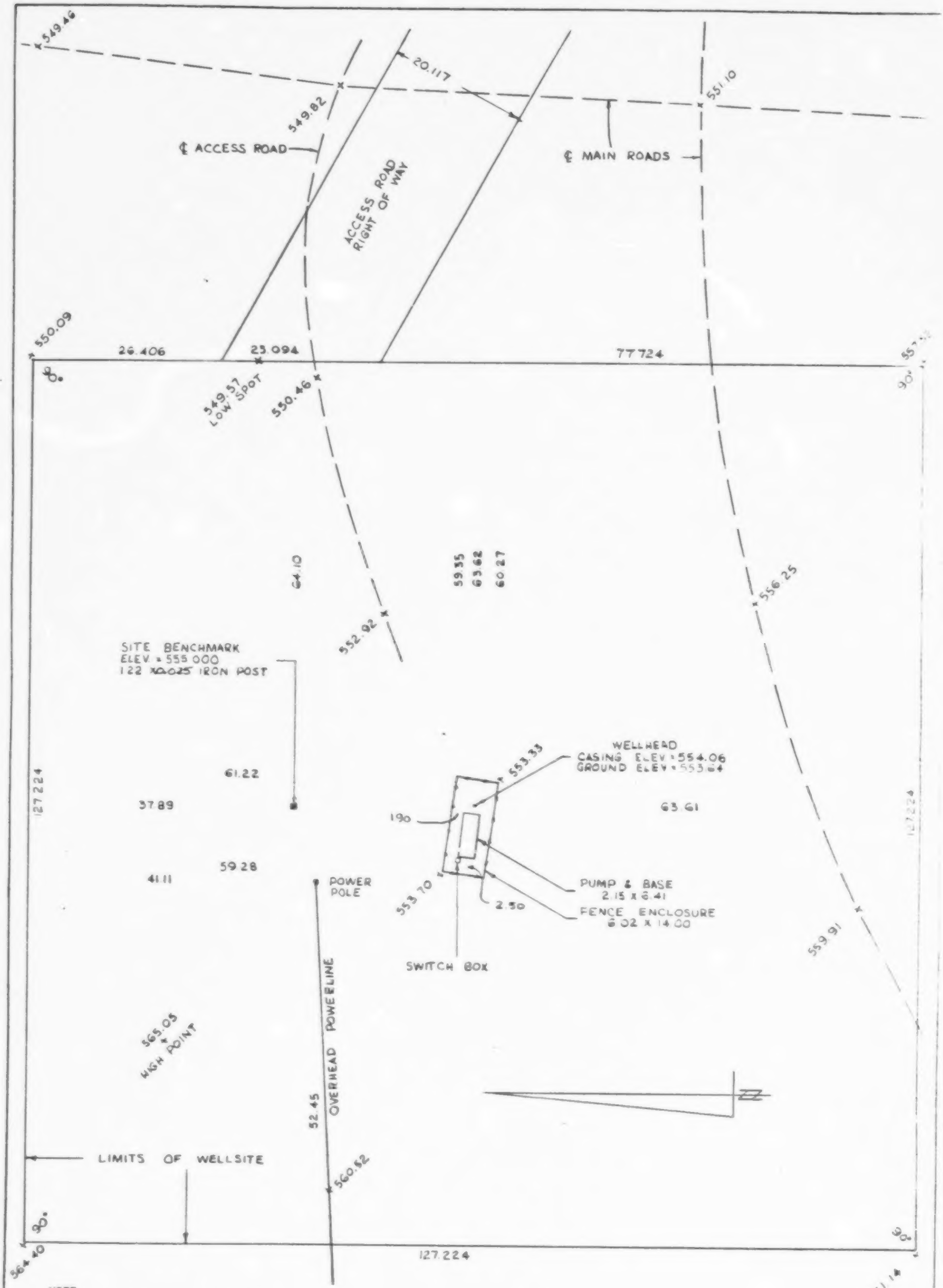
SCALE: 1:500
DATE: NOV. 25, 1986
DRAWN BY: G.A.R.
DRAWING NO.: 2500-37


548.98
POLE
548.91
548.15
60.96
543.22
18.35
90°
36.82
34.19
32.37
549.29
FENCE ENCLOSURE
9.87 X 11.63
548.92
30.23
32.18
31.96
30.05
SITE BENCHMARK
ELEV = 555.000
1.22 X 0.025 IRON POST
19.29
548.75
548.23
BUILDING
6.09 X 7.98
551.17
548.56
33.88
129.54
22.20
FLARE
14.77
548.29
548.39
34.03
FENCE
ENCLOSURE
12.16 X 13.49
℄ ACCESS ROAD
53 33
60 00
86 25
LIMITS OF BATTERY SITE
548.93
40.843
20.117
548.43
548.29
ACCESS ROAD
RIGHT OF WAY

NOTE
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS . . . ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE SURVEYS LTD. REGINA, MOOSE JAW	SKETCH PLAN SHOWING WELLSITE WEYBURN UNIT 7-5-6-12 LSD 7 - SEC 5 - TWP 6 - RGE 12 - W2M	SCALE: 1:500 DATE: DEC. 4, 1984 DRAWN BY: G.A.B. DRAWING NO.: 2500-38

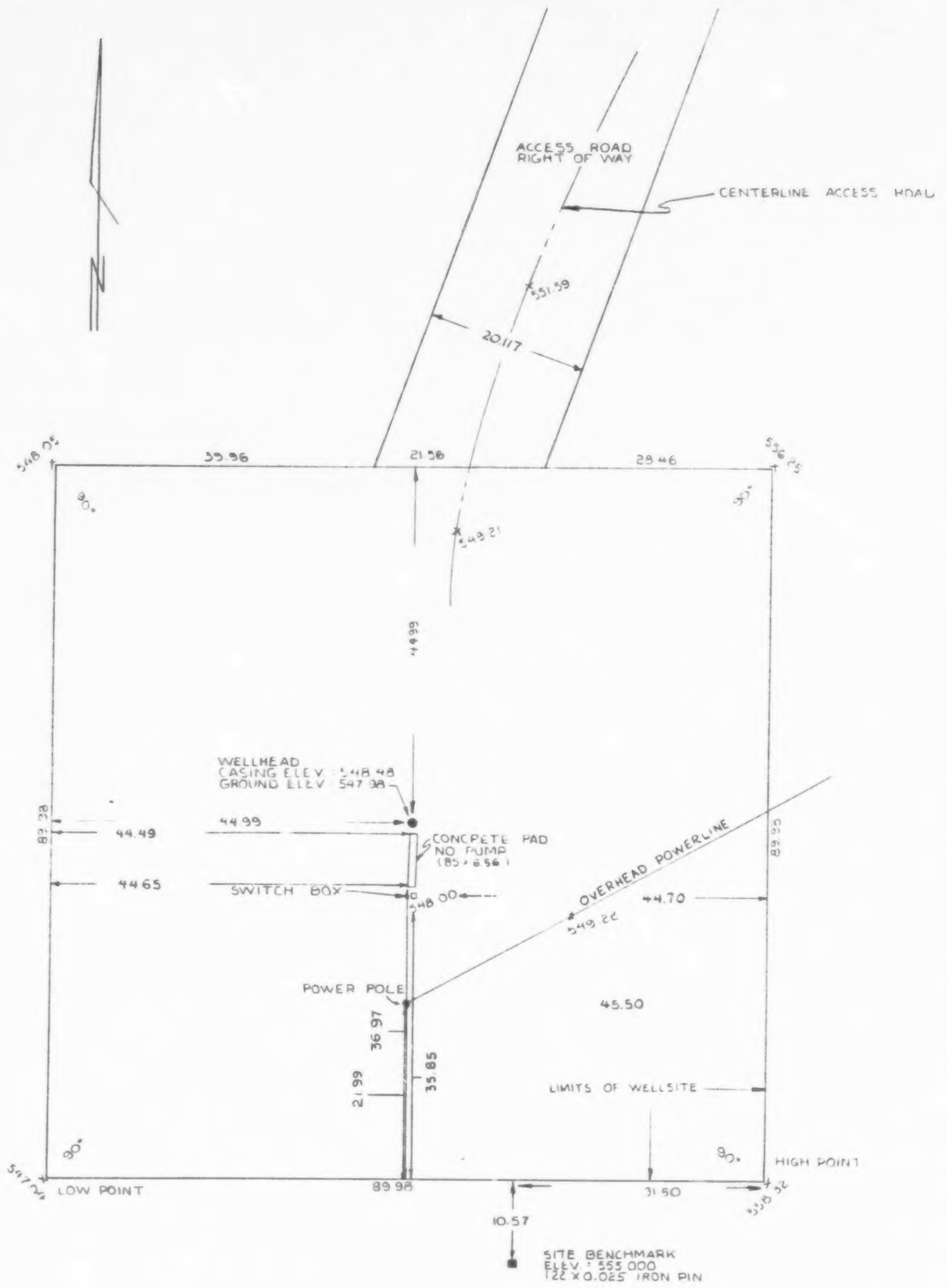

549.46
20.117
549.82
551.10
℄ ACCESS ROAD
℄ MAIN ROADS
ACCESS ROAD RIGHT OF WAY
550.09
26.406
23.094
77.724
549.57 LOW SPOT
550.46
64.10
59.35
63.62
60.27
552.92
556.25
SITE BENCHMARK
ELEV = 555.000
1.22 X 0.025 IRON POST
61.22
37.89
59.28
41.11
127.224
WELLHEAD
CASING ELEV = 554.06
GROUND ELEV = 553.64
553.33
1.90
63.61
POWER POLE
553.70
2.50
PUMP & BASE
2.15 X 6.41
FENCE ENCLOSURE
6.02 X 14.00
SWITCH BOX
559.91
565.05 HIGH POINT
OVERHEAD POWERLINE
52.45
560.52
N
LIMITS OF WELLSITE
90°
90°
90°
564.40
127.224
561.14

NOTE

DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS .. ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C C EVERETT S.L.S.

PRAIRIE SURVEYS LTD. REGINA, MOOSE JAW	SKETCH PLAN SHOWING PANCANADIAN UNIT L-M-CANADIAN SUPERIOR MAINPRIZE 2-5 WELLSITE LSD 2 -SEC 5 -TWP 6 -RGE 12 -W2M	SCALE: 1:500 DATE: NOV. 26, 1986 DRAWN BY: G.A.R. DRAWING NO.: 2500-59


N
ACCESS ROAD
RIGHT OF WAY
CENTERLINE ACCESS ROAD
551.59
20.117
548.05
39.96
21.58
28.46
556.25
90°
90°
549.21
44.99
WELLHEAD
CASING ELEV. 548.48
GROUND ELEV. 547.98
44.99
89.98
44.49
CONCRETE PAD
NO PUMP
(85 x 6.56)
89.95
44.65
SWITCH BOX
548.00
OVERHEAD POWERLINE
549.22
44.70
POWER POLE
45.50
36.97
35.85
21.99
LIMITS OF WELLSITE
90°
90°
HIGH POINT
547.25
LOW POINT
89.98
31.50
555.32
10.57
SITE BENCHMARK
ELEV. 555.000
1.22 X 0.025 IRON PIN

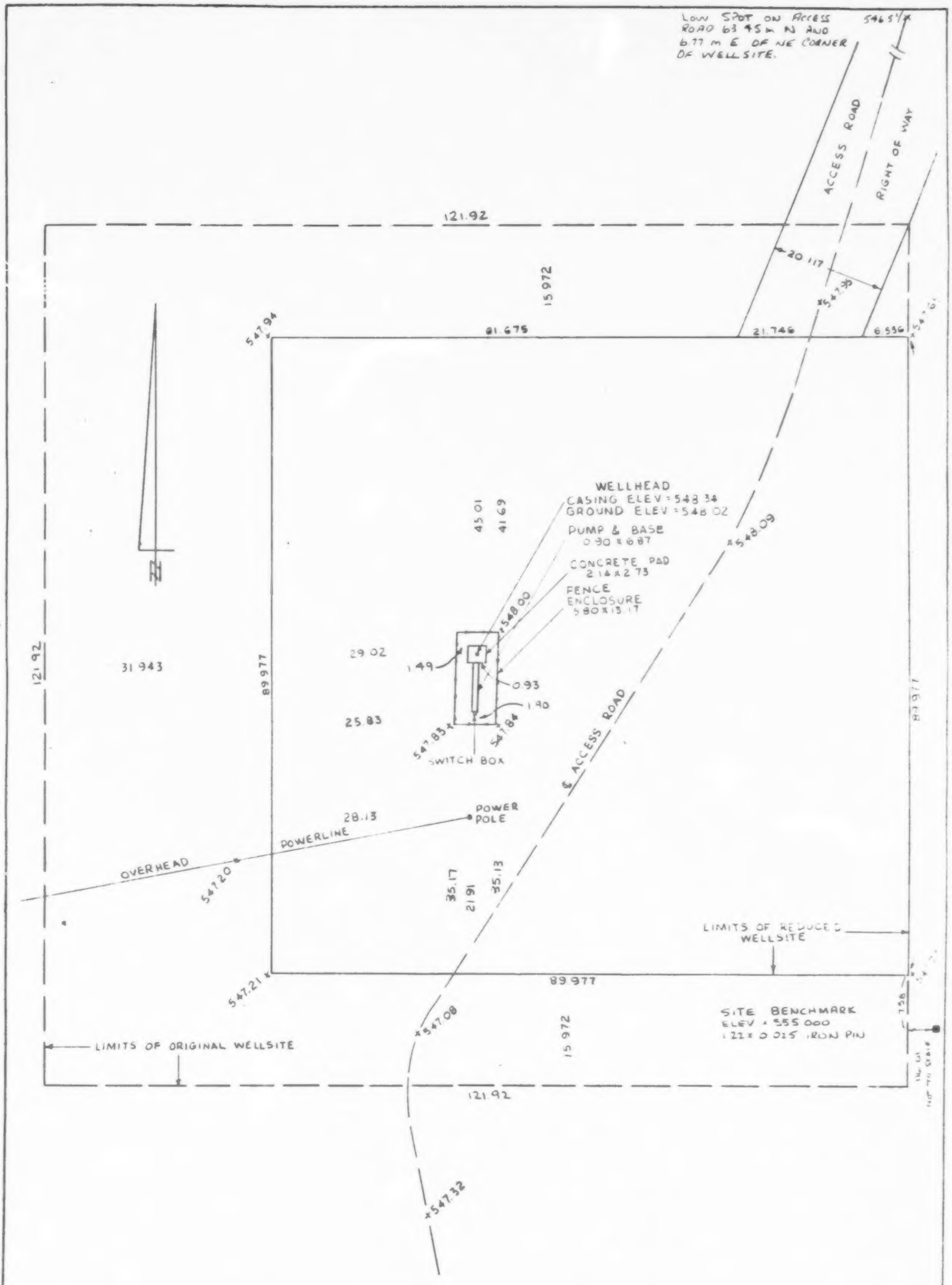
NOTE
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS.... ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE
SURVEYS LTD.
REGINA, MOOSE JAW

SKETCH PLAN
SHOWING PANCANADIAN UNIT
WELLSITE WEYBURN G-16-32
LSD 16-SEC 32-TWP 5 -RGE 12 -W2M

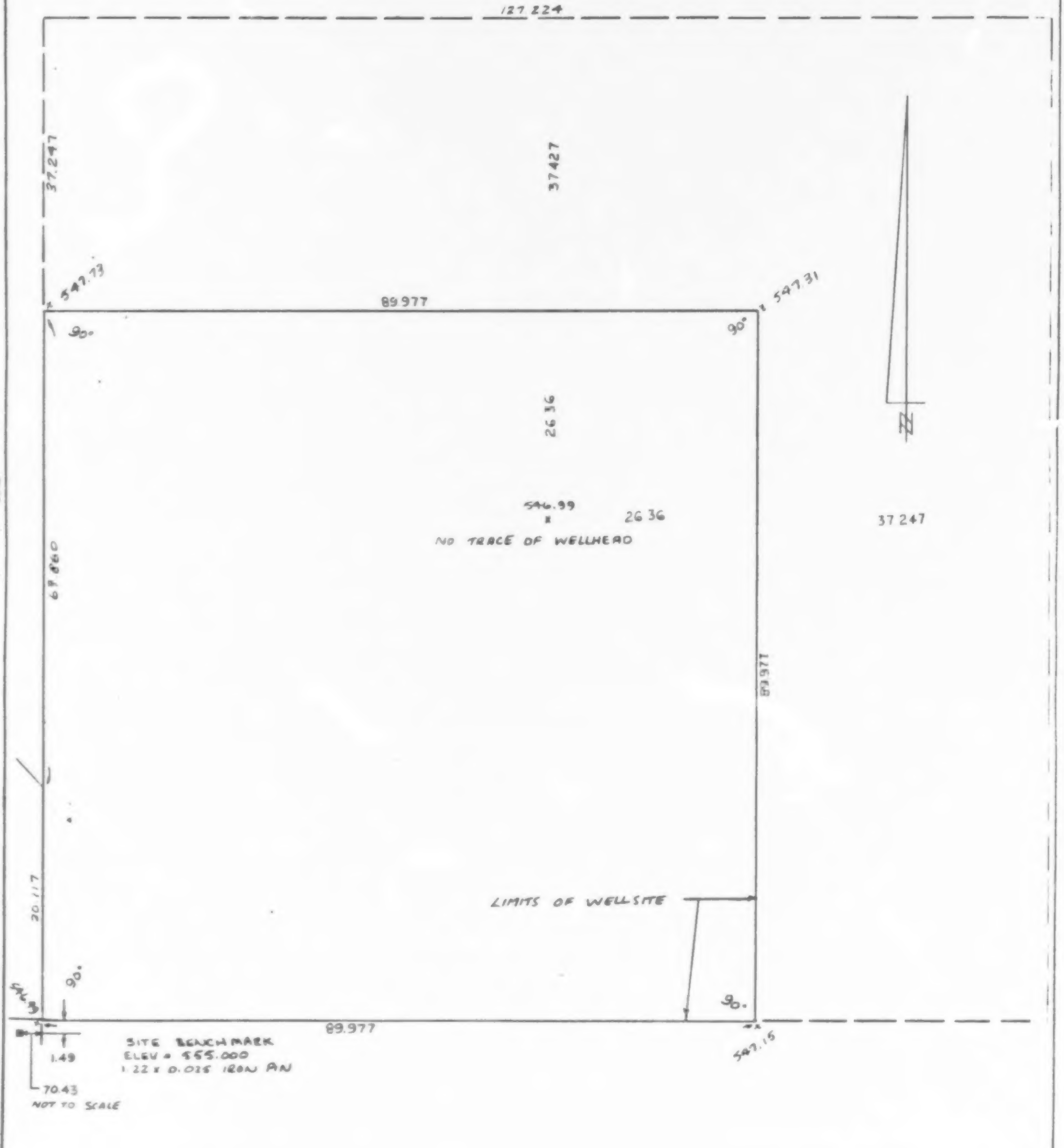
SCALE: 1:500
DATE: DEC 18, 1986
DRAWN BY: JVZ
DRAWING NO.: 2500-40


LOW SPOT ON ACCESS ROAD 63.95 m N AND 6.77 m E OF NE CORNER OF WELLSITE.
546.54
ACCESS ROAD
RIGHT OF WAY
121.92
20.117
547.35
15.972
547.94
81.675
21.746
6.556
N
WELLHEAD
CASING ELEV = 548.34
GROUND ELEV = 548.02
PUMP & BASE
0.90 x 6.87
CONCRETE PAD
2.14 x 2.73
FENCE ENCLOSURE
5.80 x 13.17
45.01
41.69
548.09
548.00
29.02
1.49
0.93
1.90
25.83
547.83
547.84
SWITCH BOX
121.92
31.943
89.977
89.977
℄ ACCESS ROAD
28.13
POWER POLE
OVERHEAD
POWERLINE
547.20
35.17
21.91
35.13
LIMITS OF REDUCED WELLSITE
547.21
89.977
SITE BENCHMARK
ELEV = 555.000
1.22 x 0.025 IRON PIN
7.58
547.08
15.972
LIMITS OF ORIGINAL WELLSITE
121.92
NOT TO SCALE
547.32

NOTE
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS . . . . ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE SURVEYS LTD. REGINA, MOOSE JAW	SKETCH PLAN SHOWING WELLSITE PANCANADIAN UNIT SHELL WEYBURN 6-2-32-5-12 LSD 2 - SEC 32 - TWP 5 - RGE 12 - W2M	SCALE: 1:500 DATE: NOV. 26, 1986 DRAWN BY: G.A.R. DRAWING NO.: 2500-41

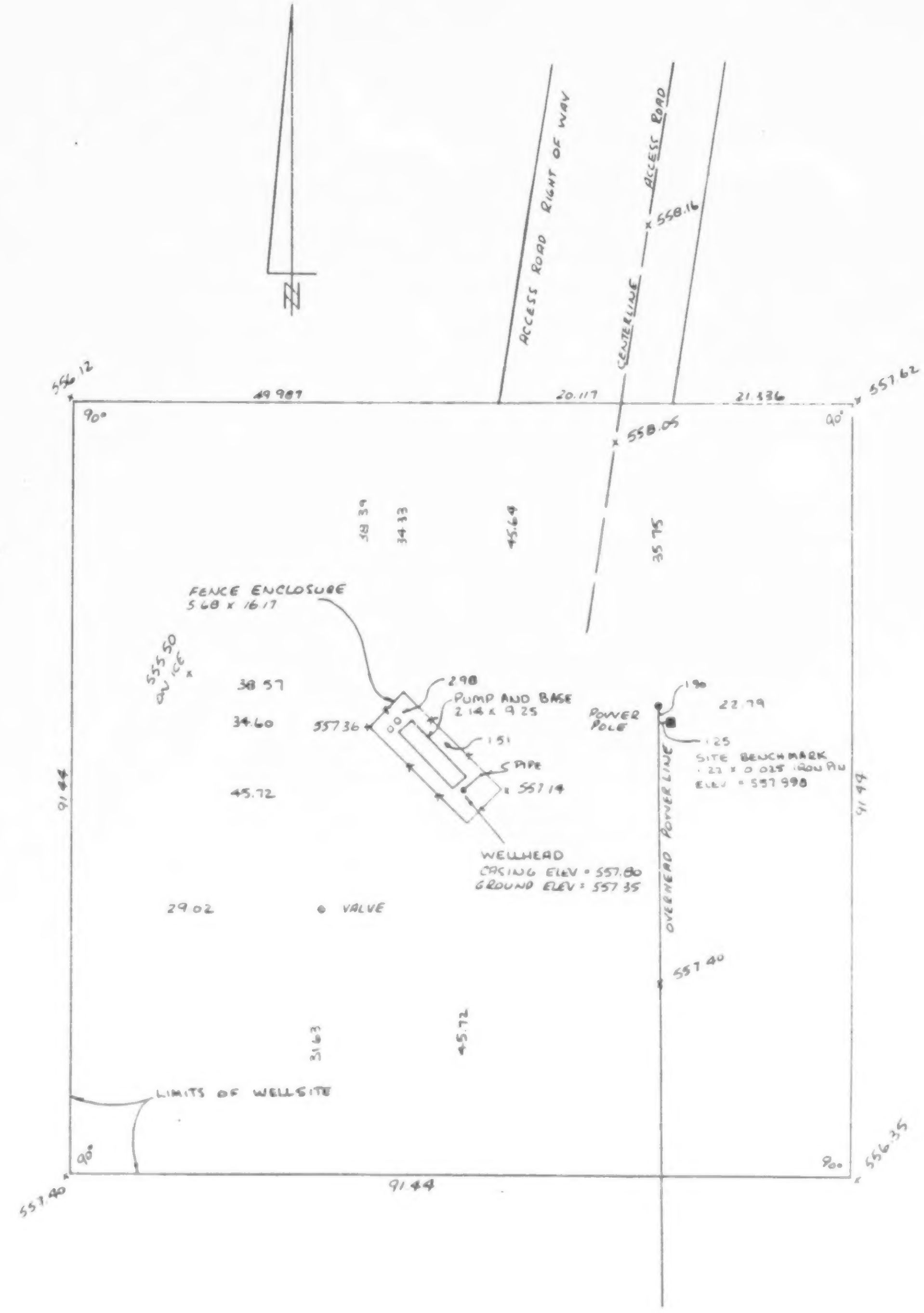

127.224
37.247
37427
547.73
89977
547.31
90°
90°
26 36
546.99
26 36
37 247
NO TRACE OF WELLHEAD
67.860
89.977
20.117
LIMITS OF WELLSITE
90°
90°
546.3
89.977
547.15
N
1.49
70.43
NOT TO SCALE

SITE BENCHMARK
ELEV = 555.000
1.22 x 0.025 IRON PIN

NOTE
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS.......... ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE SURVEYS LTD. REGINA, MOOSE JAW	SKETCH PLAN SHOWING WELLSITE TEXACO WEYBURN 14-29 LSD14 -SEC29-TWP5 -RGE 12 -W2M	SCALE: 1:500 DATE: DEC. 4, 1986 DRAWN BY: G.A.R. DRAWING NO.: 2500-42


N
ACCESS ROAD RIGHT OF WAY
ACCESS ROAD
CENTERLINE
x 558.16
556.12
49.989
20.117
21.336
x 557.62
90°
90°
x 558.05
38.39
34.33
45.64
35.75
FENCE ENCLOSURE
5.68 x 16.17
555.50
ON ICE x
38.57
2.98
PUMP AND BASE
2.14 x 9.25
34.60
557.36
1.51
5 PIPE
x 557.14
45.72
POWER
POLE
1.90
22.79
1.25
SITE BENCHMARK
.22 x 0.025 IRON PIN
ELEV = 557.998
91.44
91.44
WELLHEAD
CASING ELEV = 557.80
GROUND ELEV = 557.35
OVERHEAD POWER LINE
29.02
VALVE
557.40
31.63
45.72
LIMITS OF WELLSITE
90°
90°
557.40
91.44
556.35

NOTE

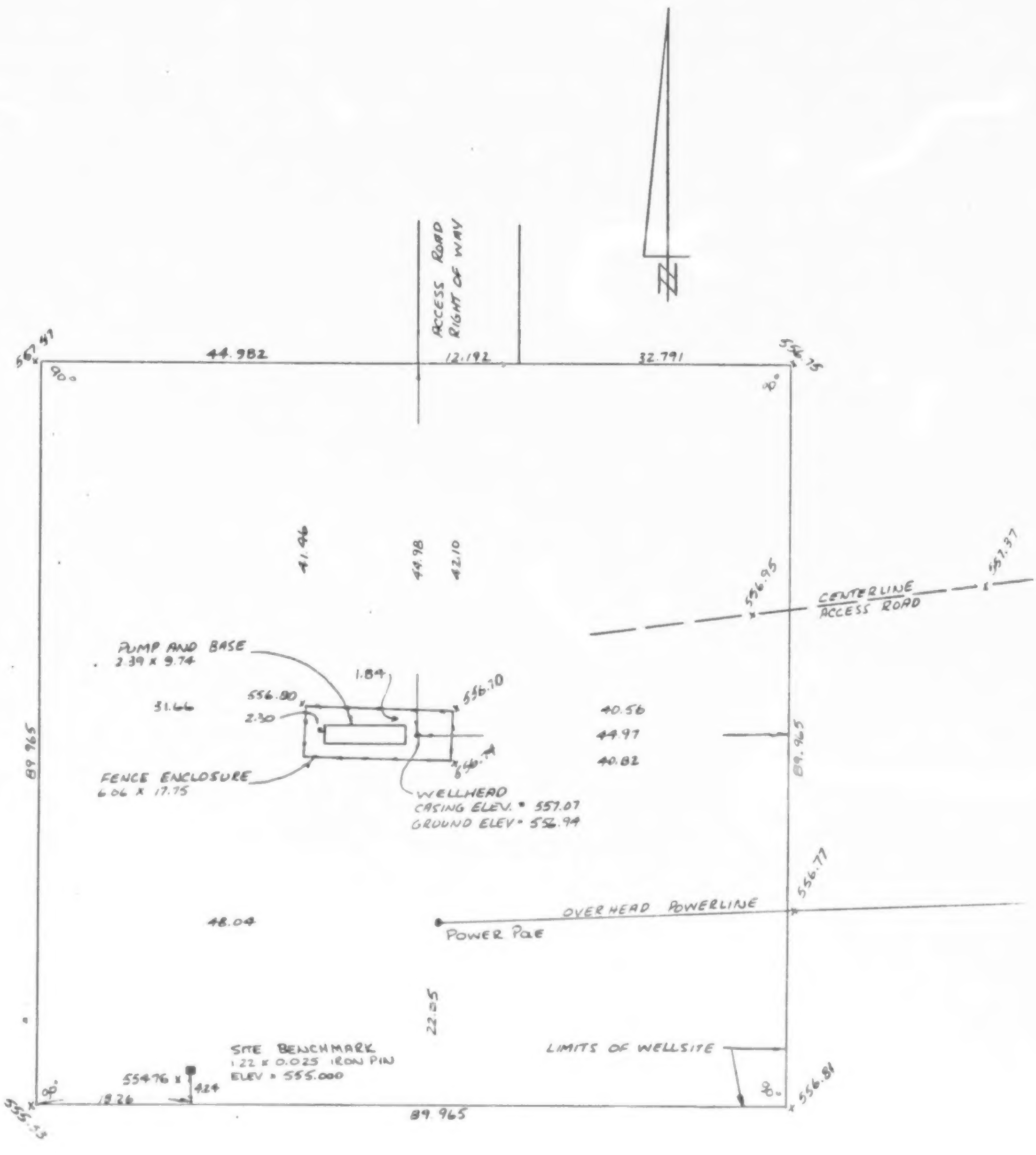
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS .... ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C C EVERETT S.L.S.

PRAIRIE
SURVEYS LTD.
REGINA, MOOSE JAW

SKETCH PLAN
SHOWING
WELLSITE
PANCANADIAN UNIT
TRANS EMPIRE
RALPH 14-21
LSD 14 - SEC 21 - TWP 6 - RGE 13 - W2M

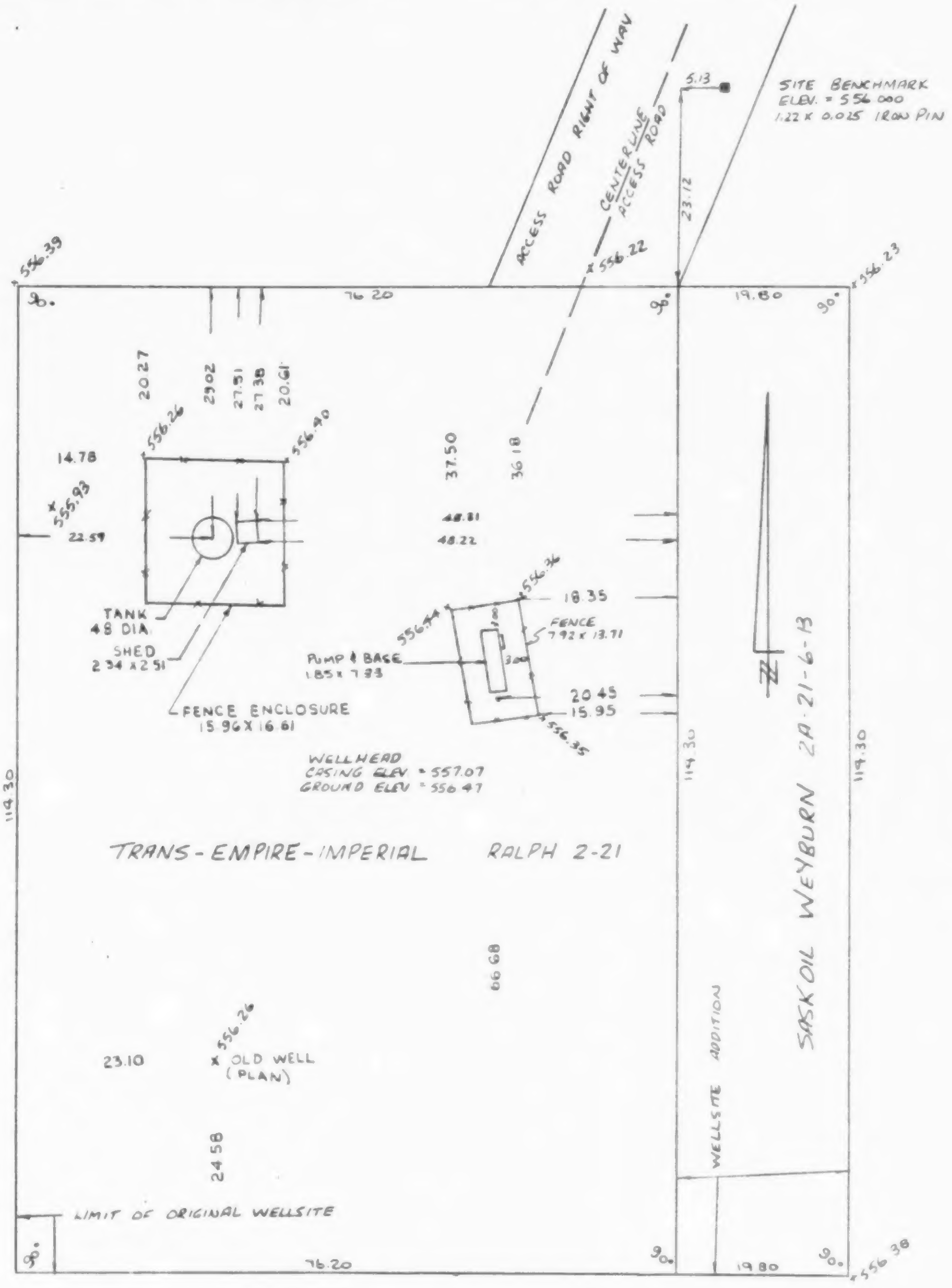
SCALE: 1:500
DATE: DEC. 1, 1986
DRAWN BY: G.A.R.
DRAWING NO.: 2500-43


ACCESS ROAD
RIGHT OF WAY
567.41
44.982
12.192
32.791
556.75
90°
41.46
44.98
42.10
556.95
CENTERLINE
ACCESS ROAD
557.37
PUMP AND BASE
2.39 x 9.74
1.84
556.80
556.70
2.30
31.66
40.56
44.97
40.82
89.965
FENCE ENCLOSURE
6.06 x 17.75
WELLHEAD
CASING ELEV. = 557.07
GROUND ELEV = 556.94
556.77
OVERHEAD POWERLINE
48.04
POWER POLE
22.05
SITE BENCHMARK
1.22 x 0.025 IRON PIN
ELEV = 555.000
LIMITS OF WELLSITE
554.76
4.24
19.26
555.53
556.81

NOTE
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS . . . . ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE SURVEYS LTD. REGINA, MOOSE JAW	SKETCH PLAN SHOWING WELLSITE TRANS EMPIRE IMPERIAL RALPH 10-21 LSD 10-SEC21-TWP 6-RGE 13-W2M	SCALE: 1:500 DATE: NOV. 28, 1986 DRAWN BY: G.A.R. DRAWING NO.: 2500-44


SITE BENCHMARK
ELEV. = 556.000
1.22 X 0.025 IRON PIN
5.13
23.12
ACCESS ROAD RIGHT OF WAY
CENTERLINE ACCESS ROAD
x 556.22
556.39
556.23
90°
76.20
19.80
20.27
29.02
27.51
27.38
20.61
556.26
556.40
14.78
x 555.93
22.59
37.50
36.18
48.81
48.22
556.36
18.35
556.44
FENCE
7.92 X 13.71
PUMP & BASE
1.85 X 7.33
1.00
3.00
20.45
15.95
556.35
TANK
48 DIA.
SHED
2.34 X 2.51
FENCE ENCLOSURE
15.96 X 16.61
WELLHEAD
CASING ELEV = 557.07
GROUND ELEV = 556.47
TRANS-EMPIRE-IMPERIAL RALPH 2-21
SASKOIL WEYBURN 2A-21-6-13
WELLSITE ADDITION
119.30
66.68
x 556.26
23.10
x OLD WELL
(PLAN)
24.58
LIMIT OF ORIGINAL WELLSITE
76.20
19.80
x 556.38

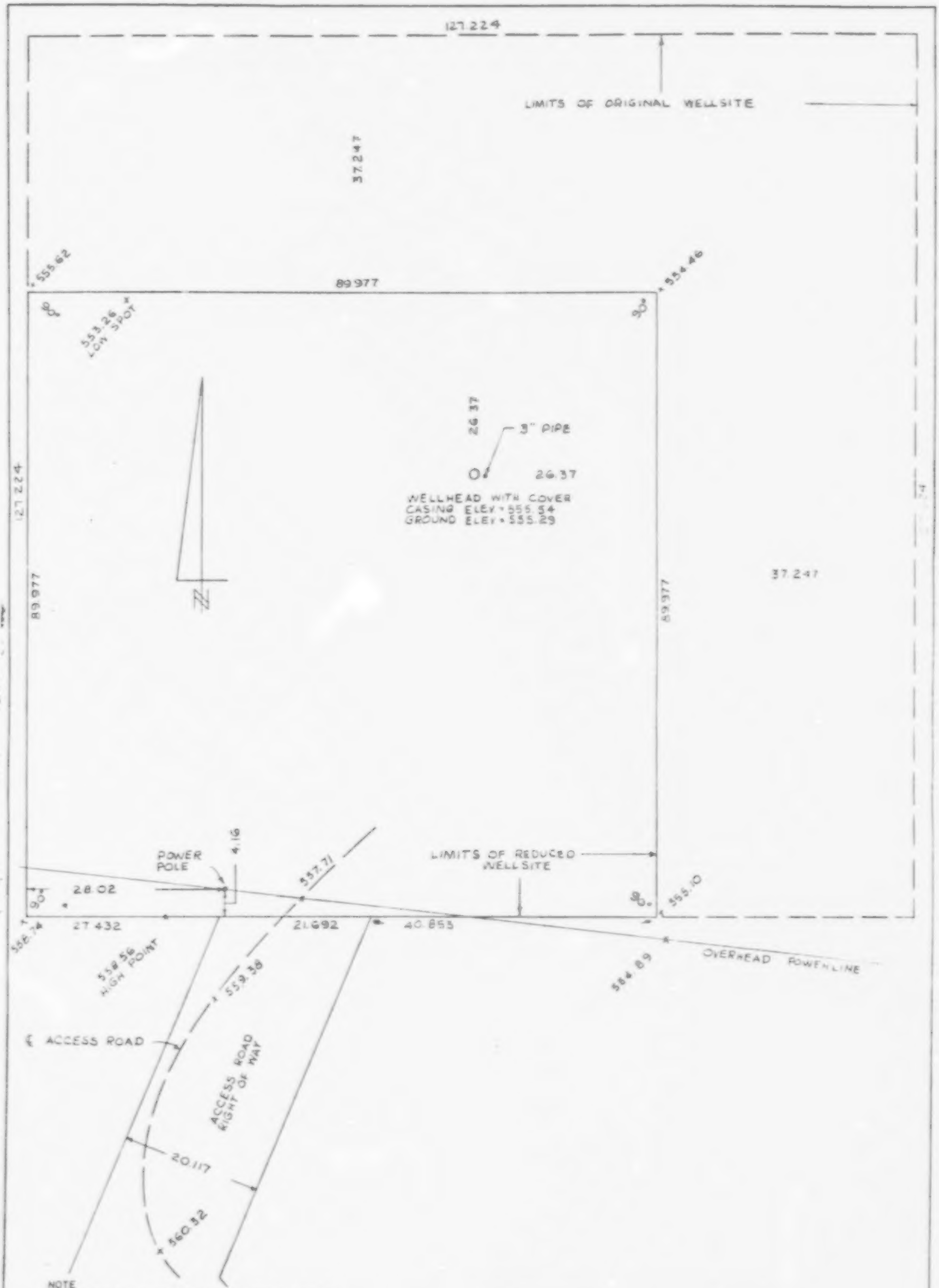
NOTE
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS . . . .
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE
SURVEYS LTD.
REGINA, MOOSE JAW

SKETCH PLAN
SHOWING
WELLSITE TRANS-EMPIRE-IMPERIAL
SASK OIL WEYBURN 2A-21-6-13
LSD 2 -SEC 21 -TWP 6 -RGE 13 -W2M

SCALE: 1:500
DATE: NOV. 28 /86
DRAWN BY: GAR
DRAWING NO.: 2500-45


127.224
LIMITS OF ORIGINAL WELLSITE
37.247
555.62
89.977
554.46
90°
553.26 LOW SPOT
90°
26.37
3" PIPE
26.37
WELLHEAD WITH COVER
CASING ELEV.=555.54
GROUND ELEV.=555.29
127.224
89.977
N
89.977
37.247
POWER POLE
4.16
LIMITS OF REDUCED WELLSITE
28.02
90°
557.71
90°
555.10
556.74
27.432
21.692
40.853
558.56 HIGH POINT
559.38
554.89
OVERHEAD POWERLINE
℄ ACCESS ROAD
ACCESS ROAD RIGHT OF WAY
20.117
560.32

NOTE

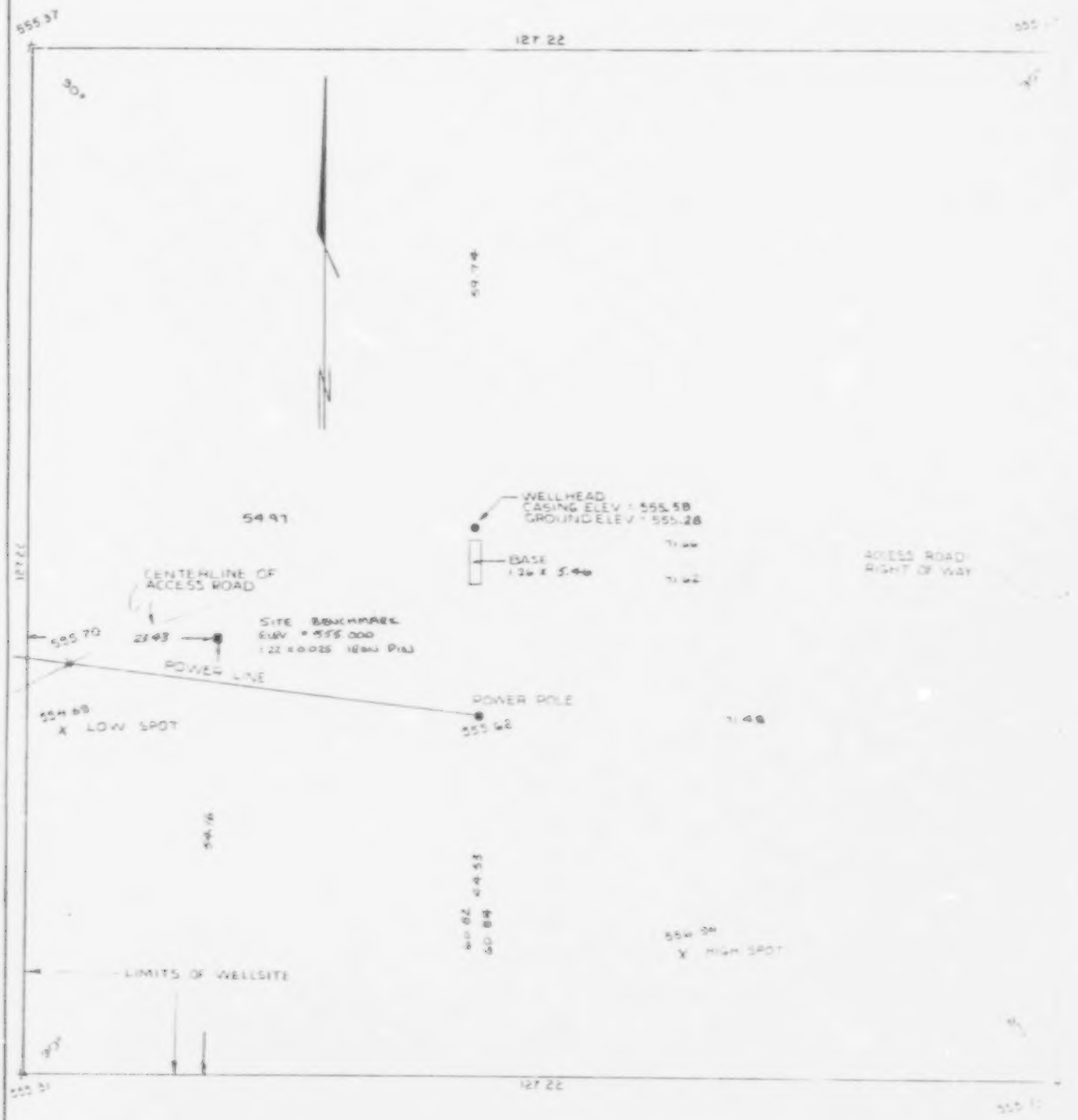
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF
SITE BENCHMARKS ARE SHOWN THUS .... ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S

PRAIRIE SURVEYS LTD.
REGINA, MOOSE JAW

SKETCH PLAN
SHOWING
WELLSITE PANCANADIAN UNIT CDR WEYBURN UNIT WDW 15-16-6-13
LSD 15 - SEC 16 - TWP 6 - RGE 13 - W2M

SCALE: 1:500
DATE: NOV. 28, 1986
DRAWN BY: G.A.R.
DRAWING NO.: 2500-46


555.37
127.22
N
59.74
54.97
WELLHEAD
CASING ELEV : 555.58
GROUND ELEV : 555.28
BASE
1.26 x 5.46
ACCESS ROAD
RIGHT OF WAY
127.22
CENTERLINE OF
ACCESS ROAD
555.70
23.43
SITE BENCHMARK
ELEV = 555.000
1.22 x 0.025 IRON PIN
POWER LINE
POWER POLE
555.62
554.69
x LOW SPOT
54.16
24.53
60.62
60.84
554.94
x HIGH SPOT
LIMITS OF WELLSITE
555.31
127.22

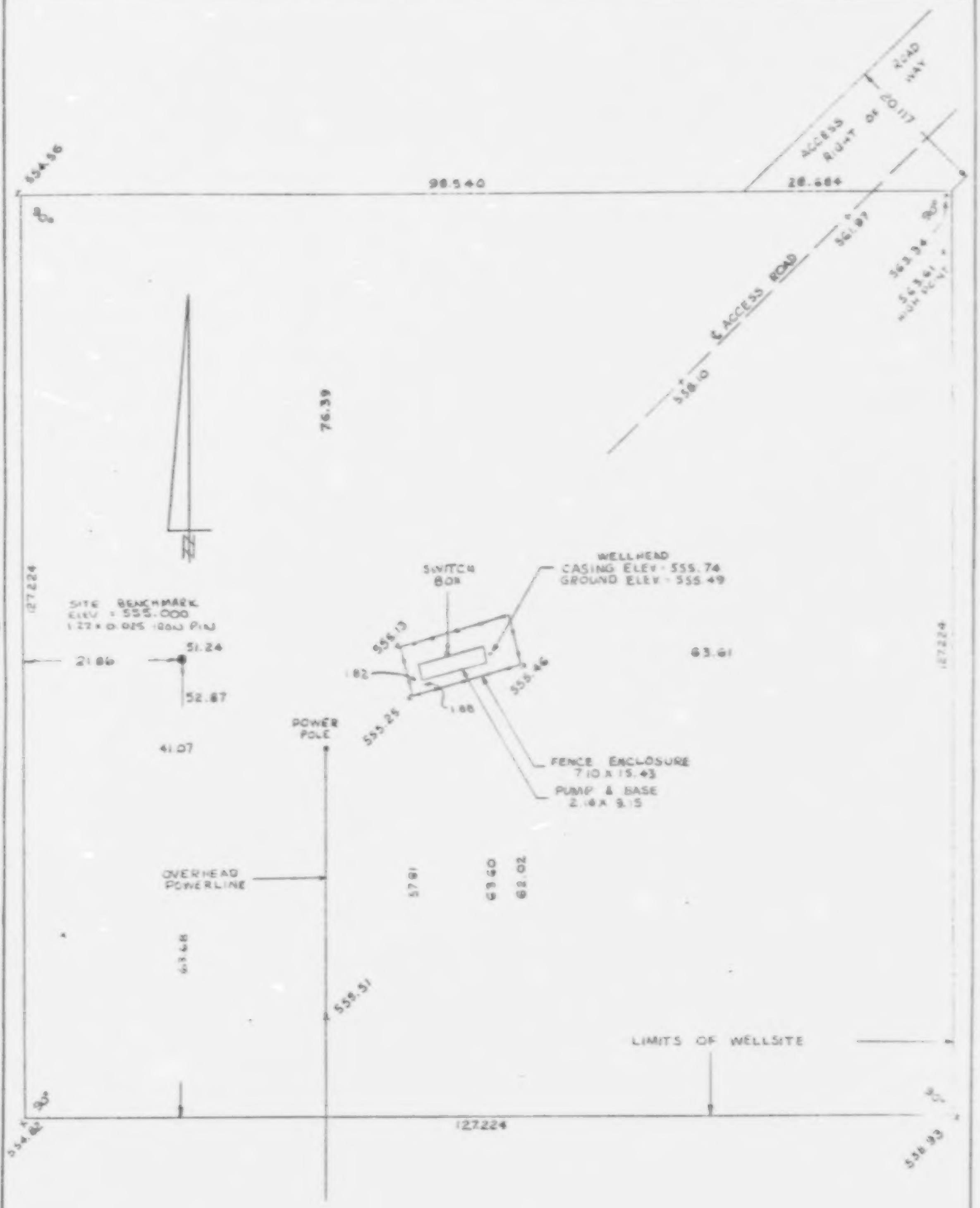
NOTE
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF
SITE BENCHMARKS ARE SHOWN THUS .
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE SURVEYS LTD.
REGINA, MOOSE JAW

SKETCH PLAN
SHOWING PANCANADIAN UNIT CENTRAL DEL RIO SOUTH RALPH 16-16
WELLSITE
LSD16-SEC16-TWP6-RGE13-W2M

SCALE: 1:500
DATE: DEC 19, 1986
DRAWN BY: JVZ
DRAWING NO.: 2500-47



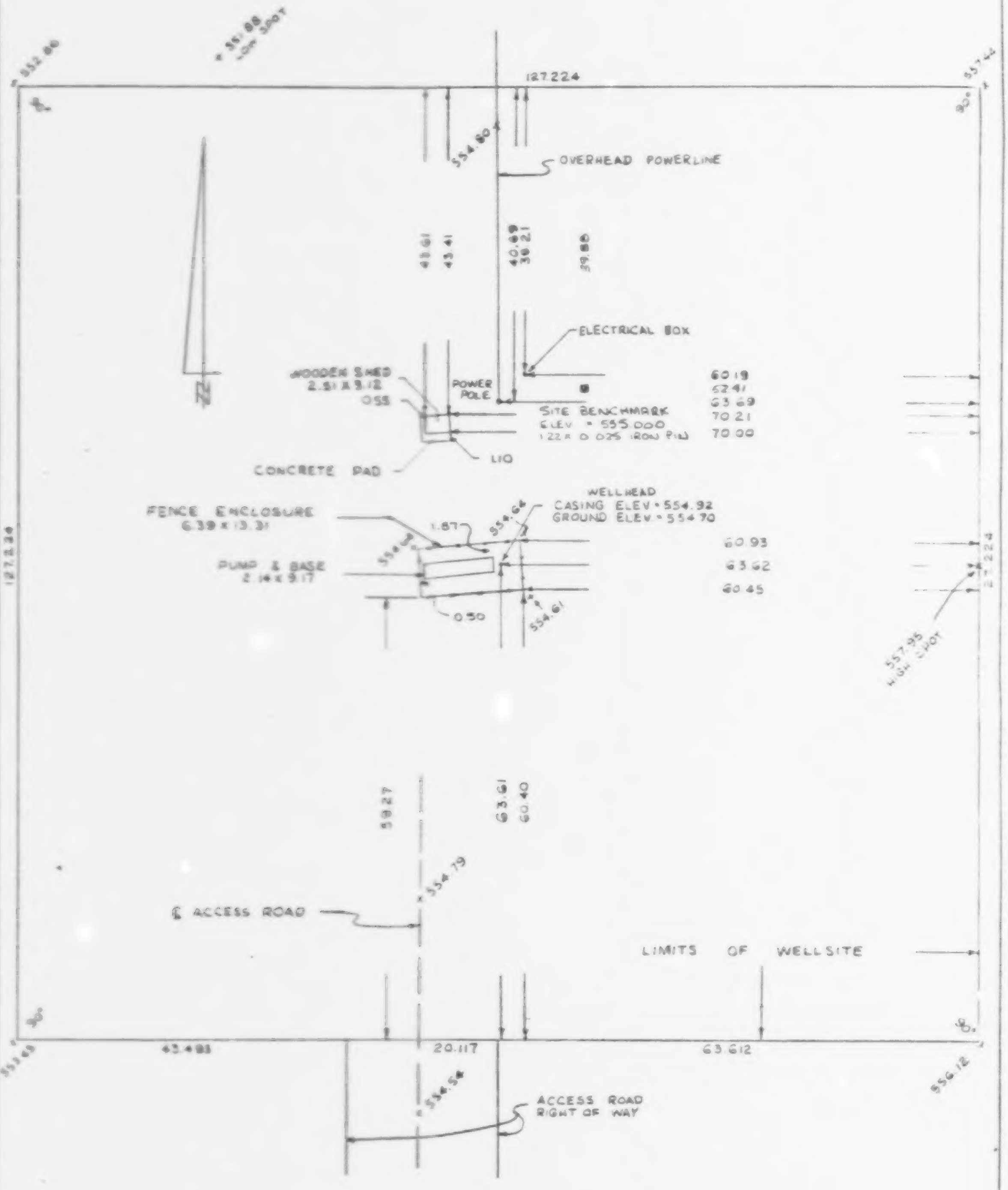
556.56
98.540
ACCESS RIGHT OF WAY
ROAD WAY
20.117
28.684
561.97
563.94
563.61 HIGH POINT
90°
558.10
℄ ACCESS ROAD
76.39
N
127.224
SITE BENCHMARK
ELEV = 555.000
1.22 x 0.025 IRON PIN
21.86
51.24
52.87
41.07
SWITCH BOX
WELLHEAD
CASING ELEV = 555.74
GROUND ELEV = 555.49
556.13
1.82
555.46
555.25
1.88
63.61
127.224
POWER POLE
FENCE ENCLOSURE
7.10 x 15.43
PUMP & BASE
2.14 x 9.15
OVERHEAD POWERLINE
57.81
63.60
62.02
63.68
555.51
LIMITS OF WELLSITE
90°
127.224
554.82
558.93

NOTE

DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS . . . . ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE SURVEYS LTD. REGINA, MOOSE JAW	SKETCH PLAN SHOWING WELLSITE MISSISSIPPIAN UNIT MOBILE OIL SOUTH RALPH 2-12-15 LSD 12-SEC 15-TWP 6-RGE 13-W2M	SCALE: 1:500 DATE: NOV 28, 1986 DRAWN BY: G A B DRAWING NO.: 2500-48


552.86
555.88 LOW SPOT
127.224
557.44
90°
554.80
OVERHEAD POWERLINE
N
43.61
43.41
40.69
38.21
39.88
ELECTRICAL BOX
WOODEN SHED
2.51 x 3.12
0.55
POWER POLE
SITE BENCHMARK
ELEV = 555.000
1.22 x 0.025 IRON PIN
60.19
62.41
63.69
70.21
70.00
1.10
CONCRETE PAD
WELLHEAD
CASING ELEV = 554.92
GROUND ELEV = 554.70
FENCE ENCLOSURE
6.39 x 13.31
1.87
554.64
554.68
PUMP & BASE
2.14 x 3.17
0.50
554.61
60.93
63.62
60.45
127.224
127.224
557.95 HIGH SPOT
39.27
63.61
60.40
554.79
℄ ACCESS ROAD
LIMITS OF WELLSITE
90°
90°
553.43
43.483
20.117
63.612
556.12
554.54
ACCESS ROAD
RIGHT OF WAY

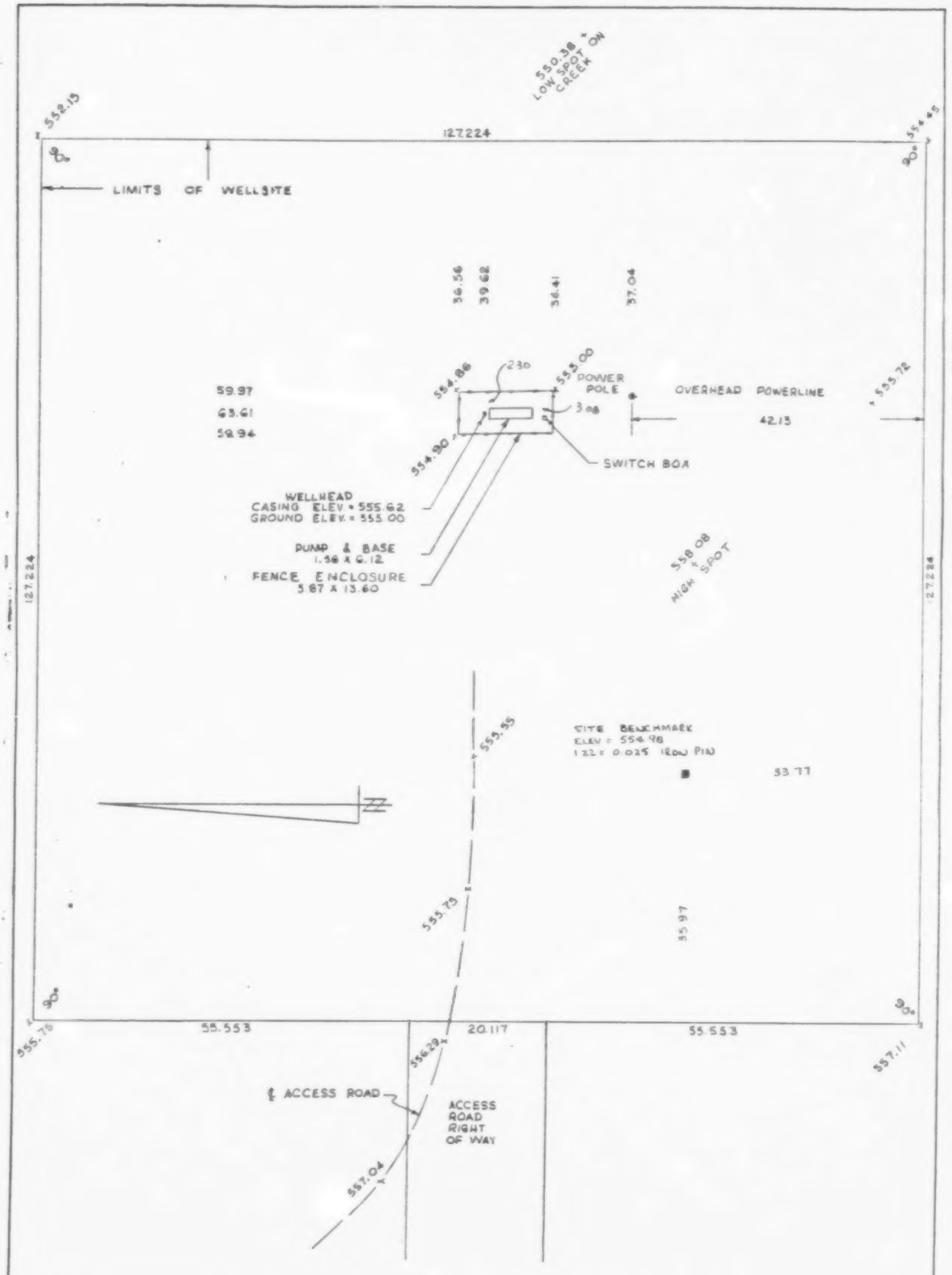
NOTE
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF
SITE BENCHMARKS ARE SHOWN THUS ■
ELEVATIONS ARE GEODETIC

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE SURVEYS LTD.
REGINA, MOOSE JAW

SKETCH PLAN
SHOWING
WELLSITE
PANCANADIAN UNIT
CENTRAL DEL RIO
SOUTH RALPH 4-15
LSD 4 - SEC 15 - TWP 6 - RGE 13 - W2M

SCALE: 1:500
DATE: NOV. 27, 1986
DRAWN BY: G.A.R.
DRAWING NO.: 2500-49


550.38 LOW SPOT ON CREEK
552.15
127.224
554.45
LIMITS OF WELLSITE
90°
36.56
39.62
36.41
37.04
59.97
63.61
59.94
554.86
2.30
555.00
POWER POLE
OVERHEAD POWERLINE
555.72
3.08
42.13
554.90
SWITCH BOX
WELLHEAD
CASING ELEV. = 555.62
GROUND ELEV. = 555.00
PUMP & BASE
1.56 X 6.12
FENCE ENCLOSURE
5.87 X 13.60
558.08 HIGH SPOT
127.224
127.224
SITE BENCHMARK
ELEV = 554.98
1.22 x 0.025 IRON PIN
555.55
33.77
555.75
35.97
N
90°
90°
555.76
55.553
20.117
55.553
557.11
556.29
℄ ACCESS ROAD
ACCESS ROAD RIGHT OF WAY
557.04

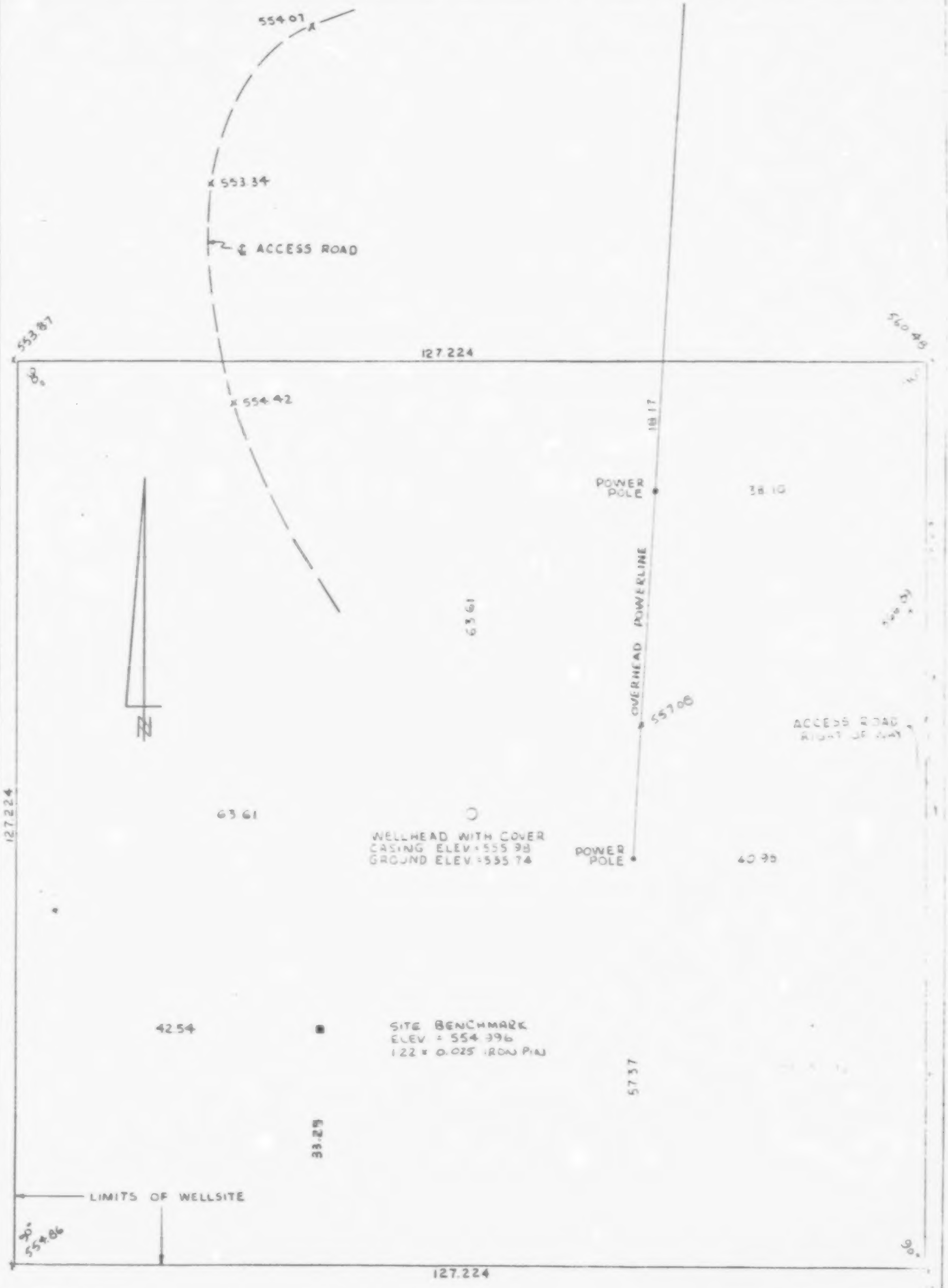
NOTE
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS .... ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE SURVEYS LTD.
REGINA, MOOSE JAW

SKETCH PLAN
SHOWING
WELLSITE
PANCANADIAN UNIT
MOBILE OIL SOUTH RALPH X-12-10
MOBILE OIL OF CANADA, LTD.
LSD 12 - SEC 10 - TWP 6 - RGE 13 - W2M

SCALE: 1:500
DATE: NOV. 27, 1986
DRAWN BY: G.A.R.
DRAWING NO.: 2500-50


554.07
× 553.34
℄ ACCESS ROAD
553.87
127.224
560.48
× 554.42
18.17
POWER POLE
38.10
63.61
OVERHEAD POWERLINE
557.08
ACCESS ROAD RIGHT OF WAY
63.61
WELLHEAD WITH COVER
CASING ELEV = 555.98
GROUND ELEV = 555.74
POWER POLE
40.95
127.224
42.54
SITE BENCHMARK
ELEV = 554.396
1.22 × 0.025 IRON PIN
57.37
33.29
LIMITS OF WELLSITE
90°
554.86
90°
127.224

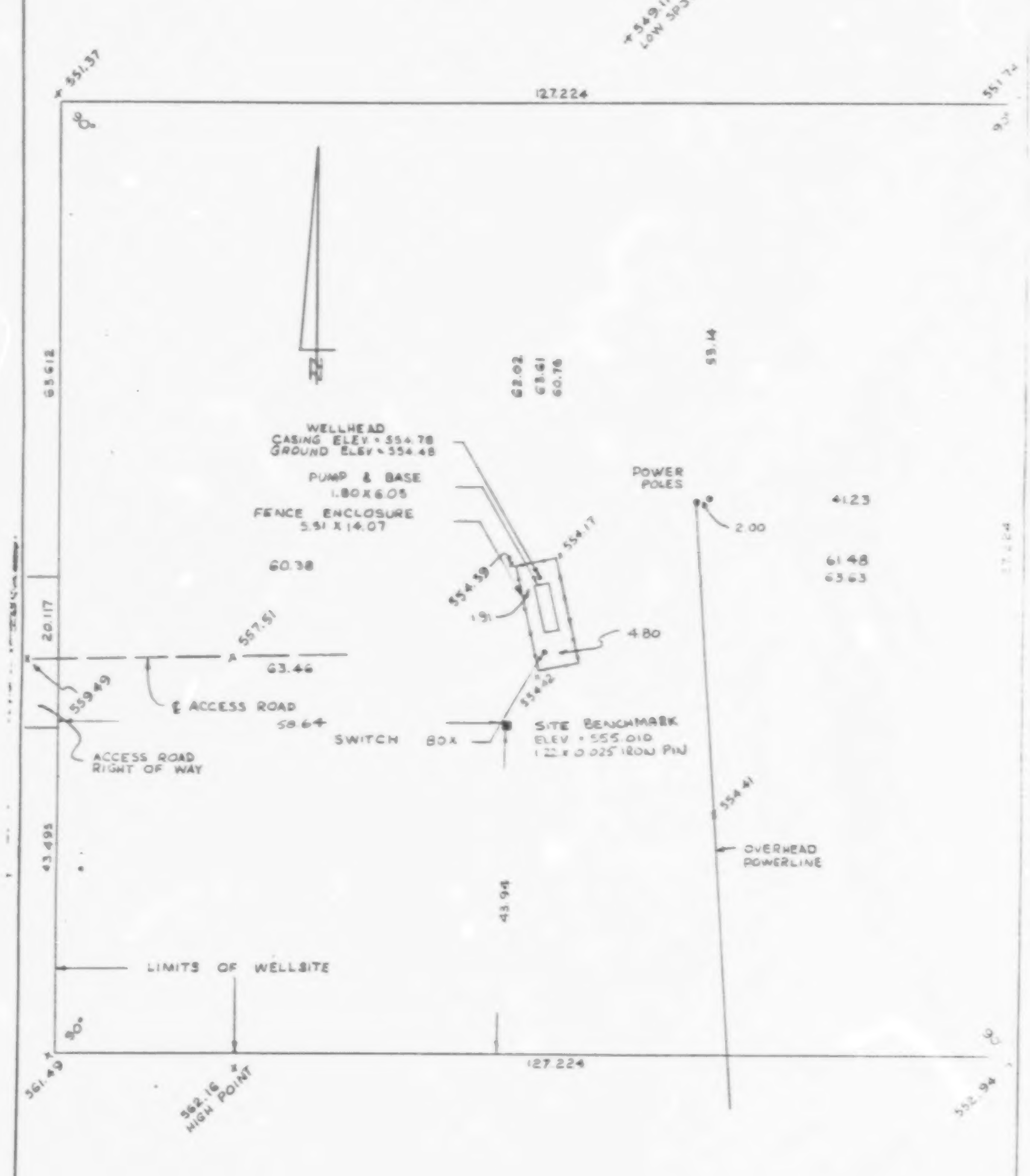
NOTE
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS .... ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE SURVEYS LTD.
REGINA, MOOSE JAW

SKETCH PLAN
SHOWING
WELLSITE
PANCANADIAN UNIT
CENTRAL-DEL RIO
SOUTH RALPH 6-10
LSD 6 -SEC 10- TWP 6 -RGE 13 - W2M

SCALE: 1:500
DATE: NOV 27, 1986
DRAWN BY: G.A.R.
DRAWING NO.: 2500-51


+549.17
LOW SPOT
x 551.37
127.224
551.74
90°
63.612
62.02
63.61
60.76
53.14
WELLHEAD
CASING ELEV = 554.78
GROUND ELEV = 554.48
PUMP & BASE
1.80 X 6.05
FENCE ENCLOSURE
5.51 X 14.07
POWER
POLES
2.00
41.23
61.48
63.63
60.38
554.17
554.39
1.91
4.80
20.117
557.51
63.46
559.49
℄ ACCESS ROAD
58.64
554.62
SWITCH BOX
SITE BENCHMARK
ELEV = 555.010
1.22 x 0.025 IRON PIN
ACCESS ROAD
RIGHT OF WAY
554.41
OVERHEAD
POWERLINE
43.495
43.94
LIMITS OF WELLSITE
90°
127.224
561.49
562.16
HIGH POINT
552.94

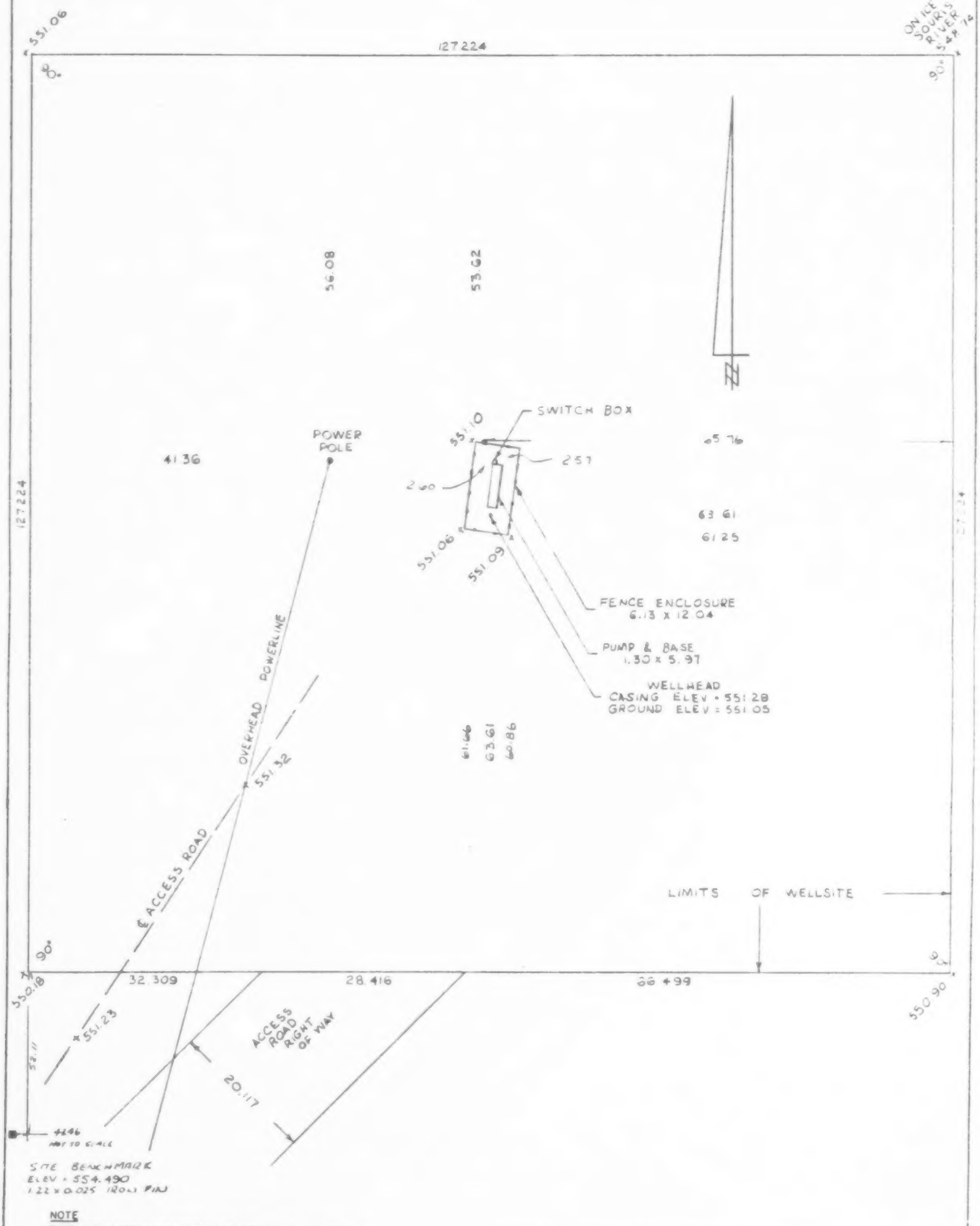
NOTE
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS .... ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE SURVEYS LTD.
REGINA, MOOSE JAW

SKETCH PLAN
SHOWING
WELLSITE
MOBILE OIL SOUTH RALPH X-14-3
MOBILE OIL OF CANADA LTD.
LSD 14 - SEC 3 - TWP 4 - RGE 13 - W2M

SCALE: 1:500
DATE: NOV. 27, 1984
DRAWN BY: G.A.B.
DRAWING NO.: 2500-52


551.06
127.224
ON ICE OF SOURIS RIVER 554.74
90°
90°
56.08
53.62
SWITCH BOX
551.10
2.57
2.60
65.76
POWER POLE
41.36
127.224
63.61
61.25
551.06
551.09
FENCE ENCLOSURE 6.13 x 12.04
PUMP & BASE 1.30 x 5.97
WELLHEAD
CASING ELEV = 551.28
GROUND ELEV = 551.05
OVERHEAD POWERLINE
61.66
63.61
60.86
551.32
℄ ACCESS ROAD
LIMITS OF WELLSITE
90°
32.309
28.416
66.499
550.18
550.90
551.23
ACCESS ROAD RIGHT OF WAY
20.117
52.11
41.46
NOT TO SCALE
SITE BENCHMARK
ELEV = 554.490
1.22 x 0.025 IRON PIN

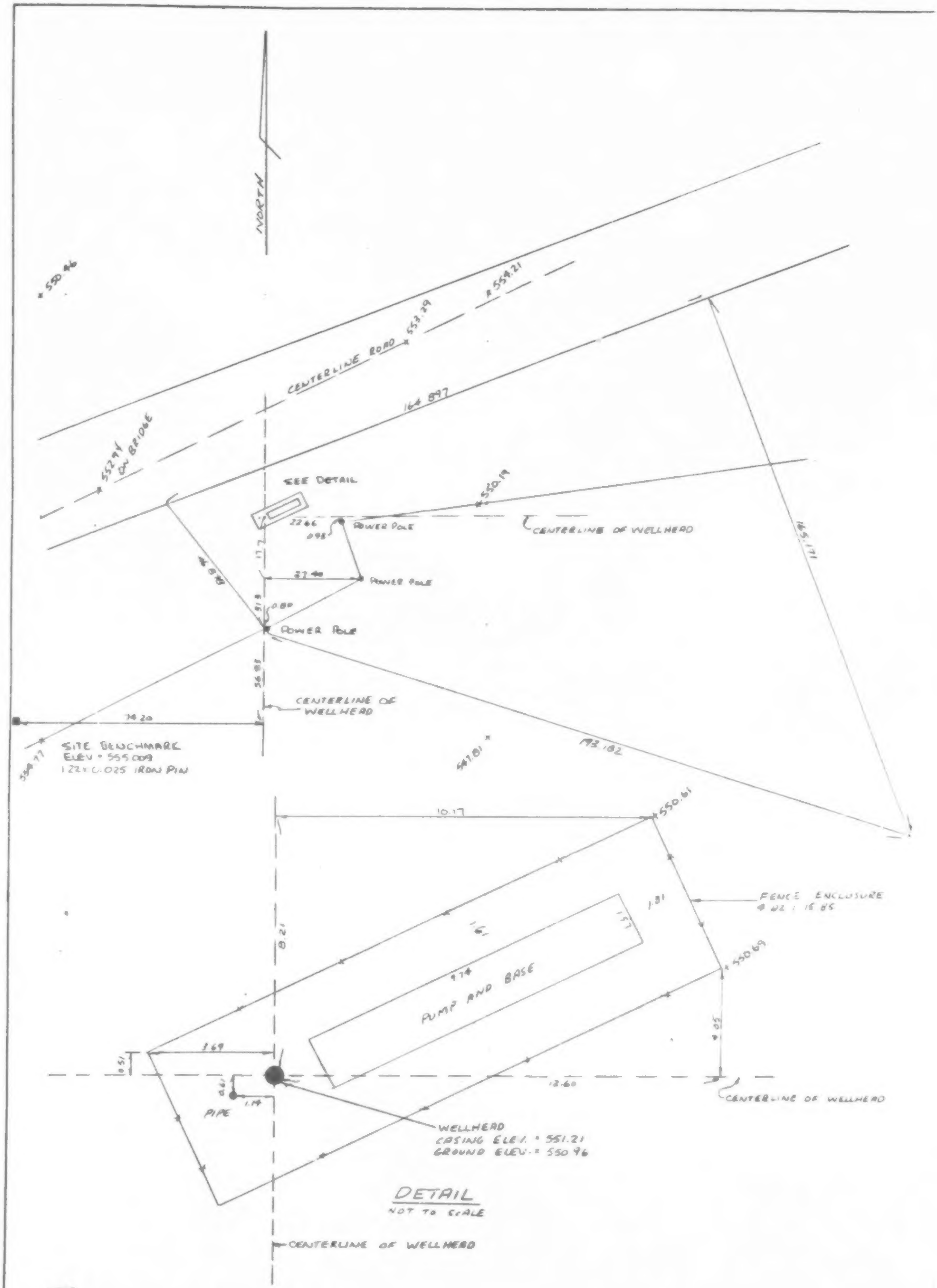
NOTE
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF
SITE BENCHMARKS ARE SHOWN THUS ■
ELEVATIONS ARE GEODETIC

CERTIFIED CORRECT C C EVERETT S L S

PRAIRIE SURVEYS LTD.
REGINA, MOOSE JAW

SKETCH PLAN
SHOWING
WELLSITE
PANCANADIAN UNIT
CENTRAL-DEL RIO OILS LTD
CENTRAL-DEL RIO SOUTH [illegible] 10-3
LSD 10 - SEC 3 - TWP 6 - RGE 13 - W2M

SCALE: 1:500
DATE: NOV. 27, 1966
DRAWN BY: G.A.R.
DRAWING NO.: 2500-53


NORTH
× 550.46
CENTERLINE ROAD
553.29
× 554.21
164.897
552.94 ON BRIDGE
SEE DETAIL
× 550.19
22.66
0.98
POWER POLE
CENTERLINE OF WELLHEAD
165.171
48.84
17.2
27.40
POWER POLE
51.8
0.80
POWER POLE
56.98
CENTERLINE OF WELLHEAD
74.20
SITE BENCHMARK
ELEV = 555.009
1.22 × 0.025 IRON PIN
554.77
547.81 ×
193.182
10.17
550.61
FENCE ENCLOSURE
4 W2 : 15.85
1.81
1.51
1.91
8.21
9.74
PUMP AND BASE
550.69
4.05
3.69
0.51
0.61
1.14
PIPE
12.60
CENTERLINE OF WELLHEAD
WELLHEAD
CASING ELEV. = 551.21
GROUND ELEV. = 550.96
DETAIL
NOT TO SCALE
CENTERLINE OF WELLHEAD

NOTE
DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
SITE BENCHMARKS ARE SHOWN THUS .... ■
ELEVATIONS ARE GEODETIC.

CERTIFIED CORRECT C.C. EVERETT S.L.S.

PRAIRIE
SURVEYS LTD.
REGINA, MOOSE JAW

SKETCH PLAN
SHOWING
WELLSITE MOBIL OIL SOUTH RALPH X-2-3
LSD2 -SEC3 -TWP6 -RGE 13 -W2M

SCALE: 1:1000
DATE: DEC 22 /86
DRAWN BY: KWK
DRAWING NO.: 2500-54

MAPS NOT

FILMED

CARTES

OMISES